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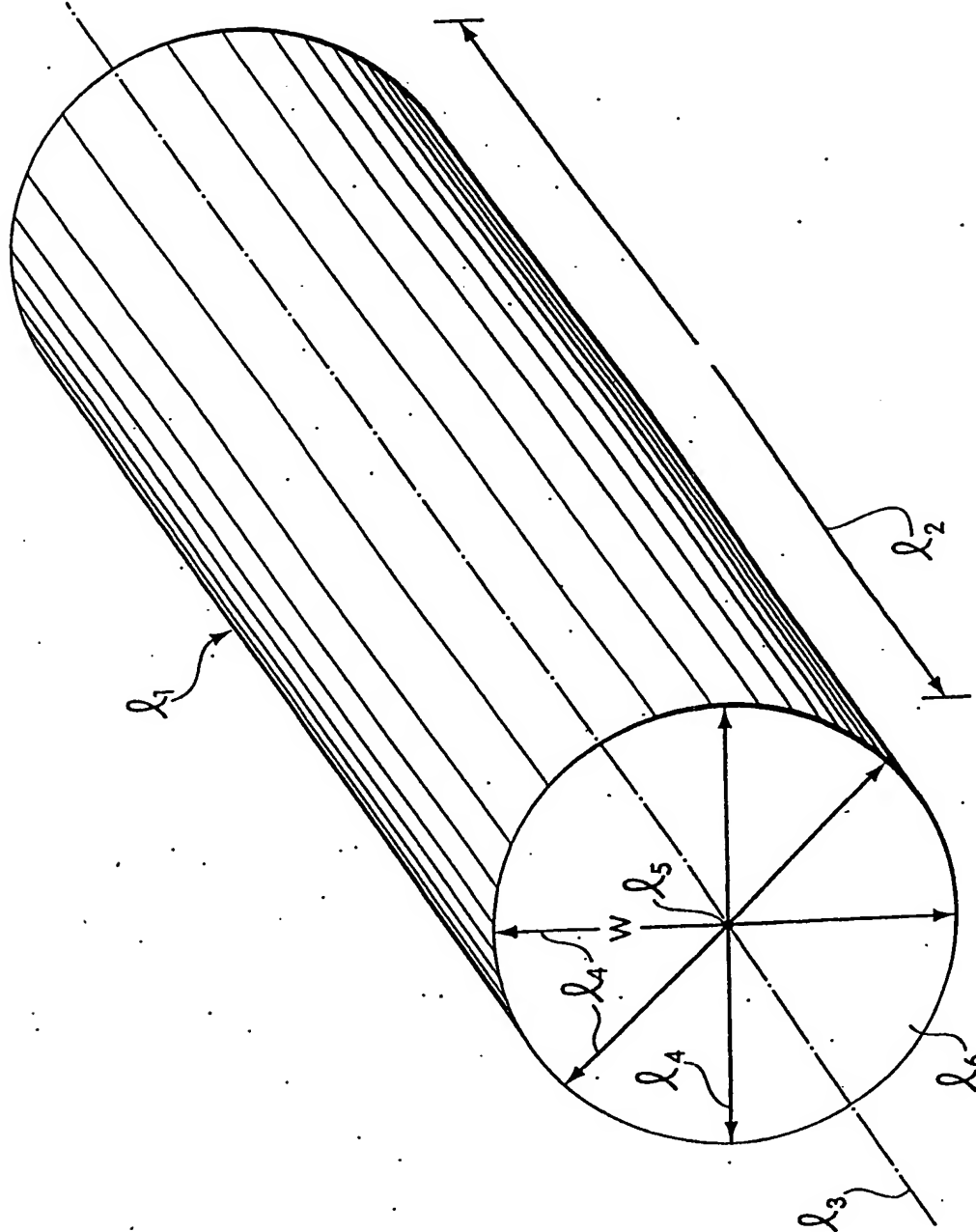


Fig. 1

H0498.70187US01

NANOSCALE WIRES AND RELATED DEVICES

By: Charles M. Lieber, et al.

Express Mail Label No.: EV292456372US

Date of Deposit: November 21, 2003

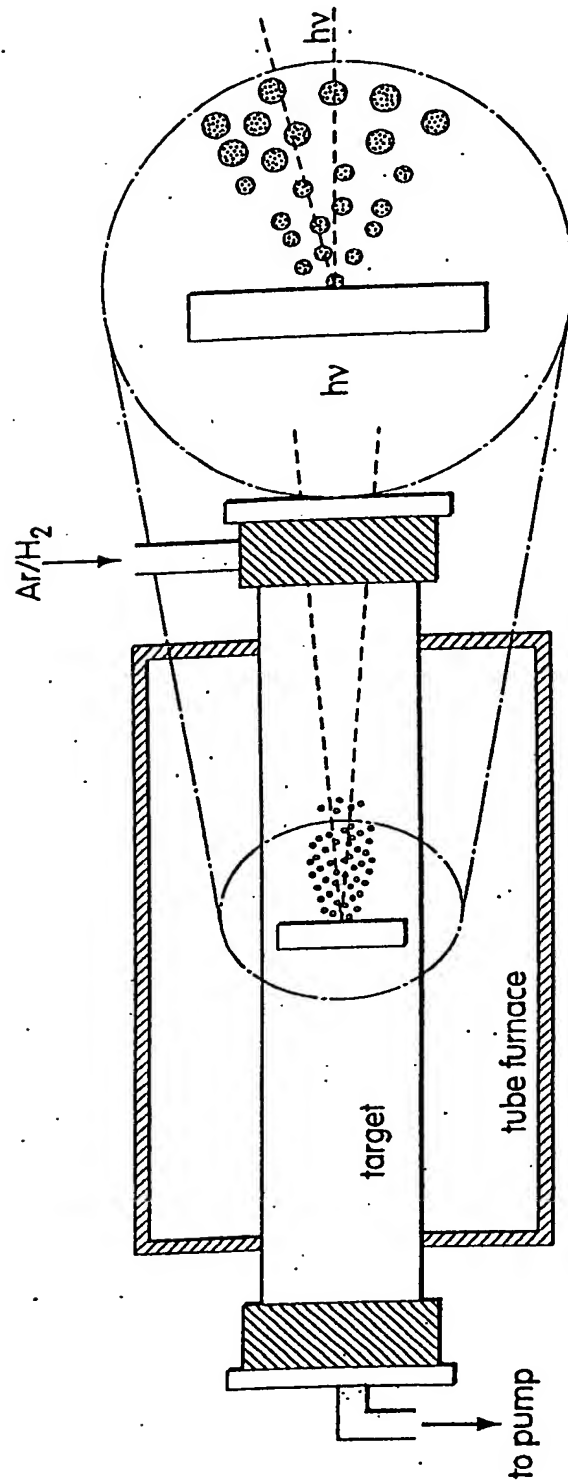


Fig. 2

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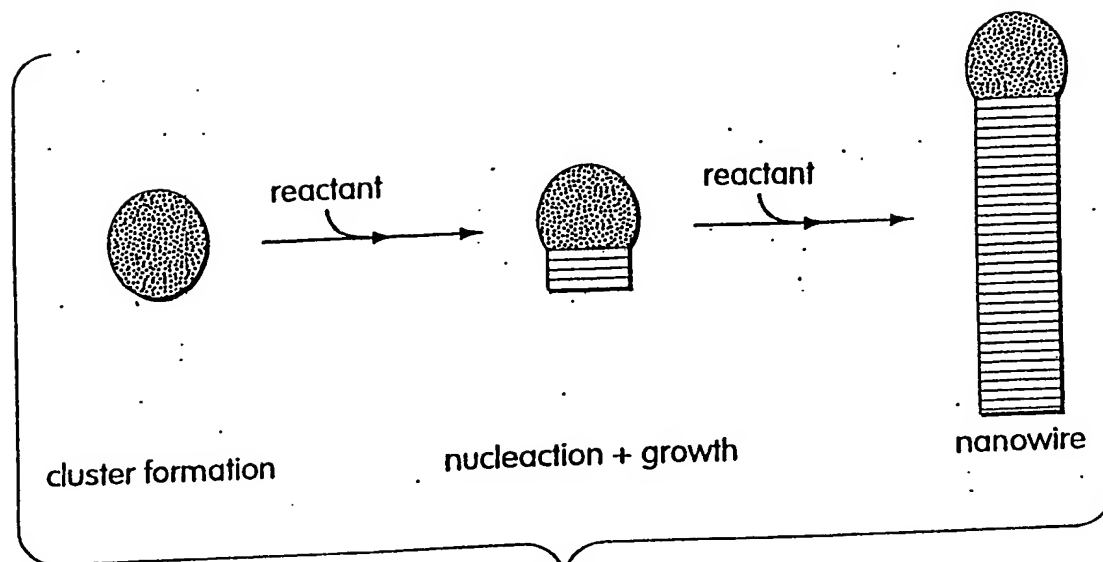


Fig. 3

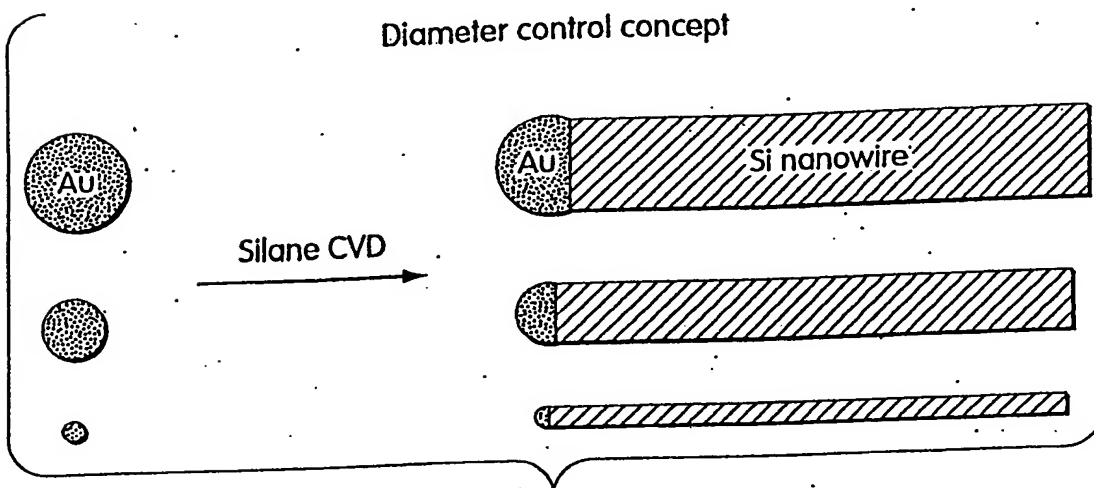


Fig. 4

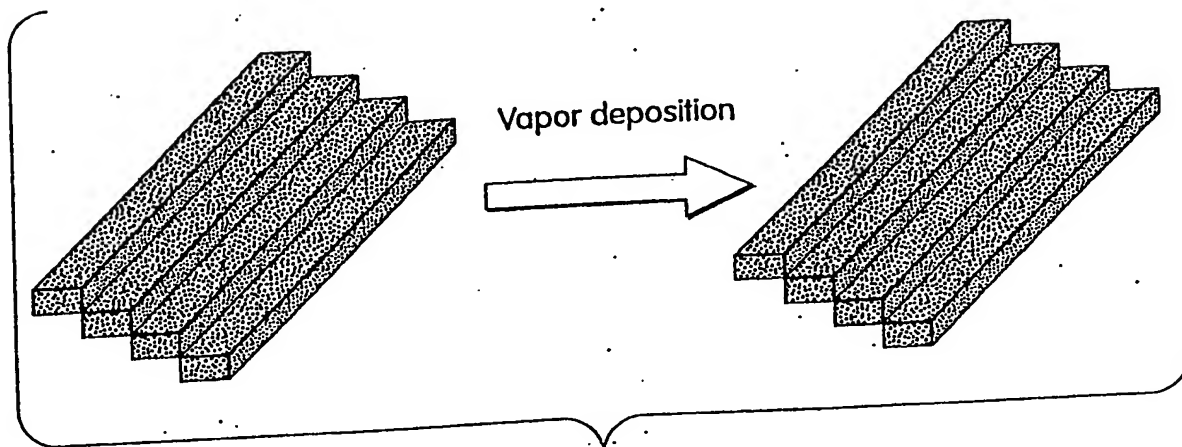


Fig. 5

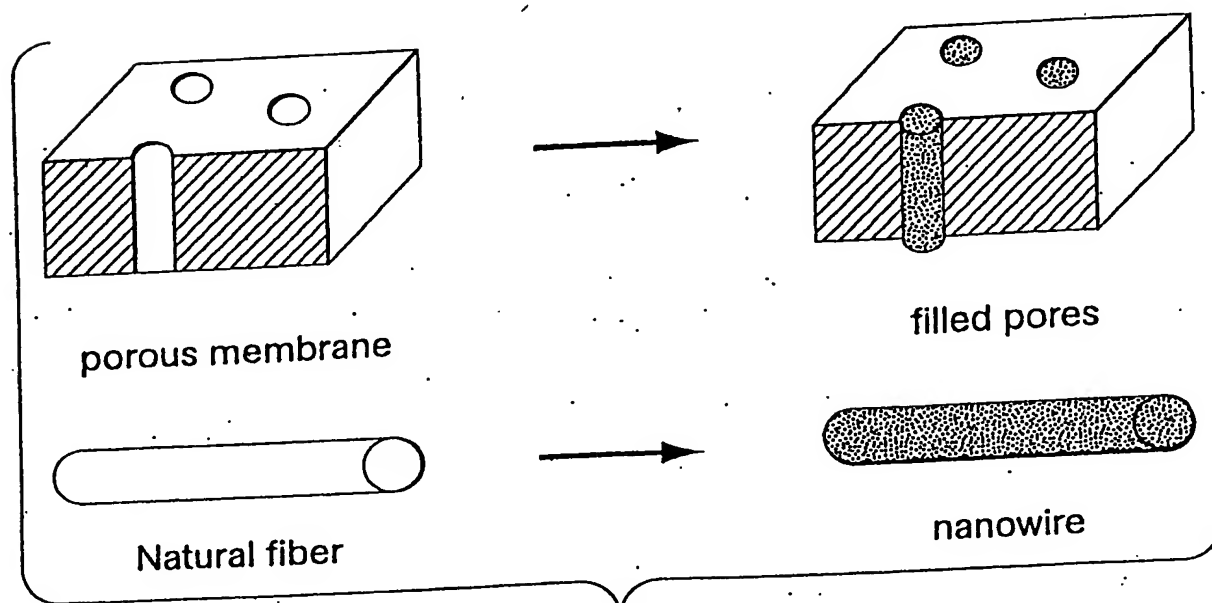


Fig. 6

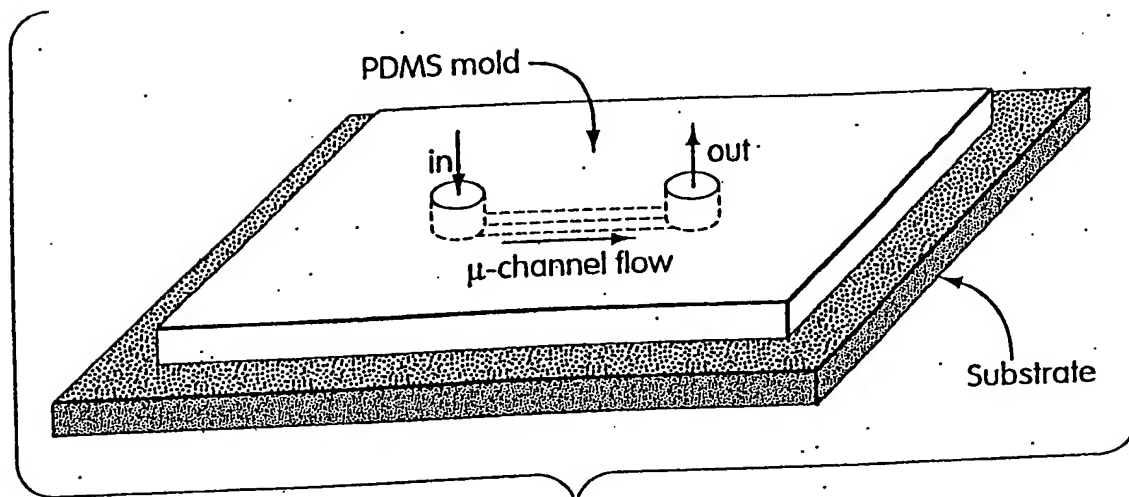


Fig. 7A

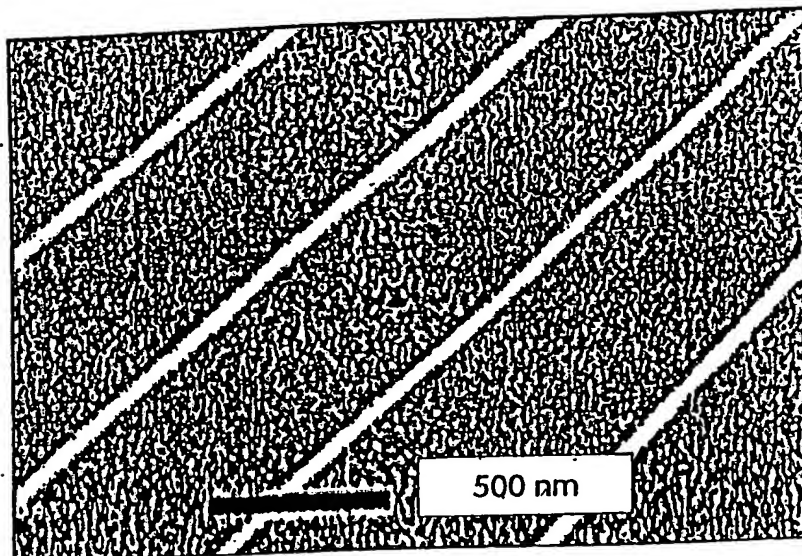


Fig. 7B

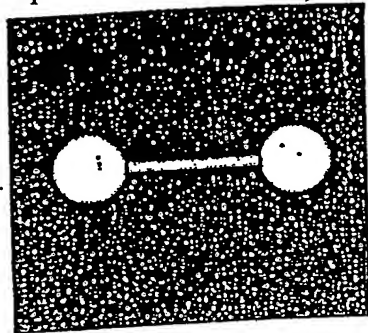
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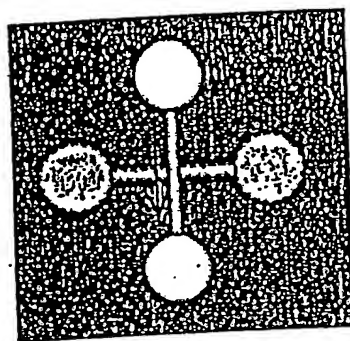
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First layer

Fig. 7C



Second layer

Fig. 7D

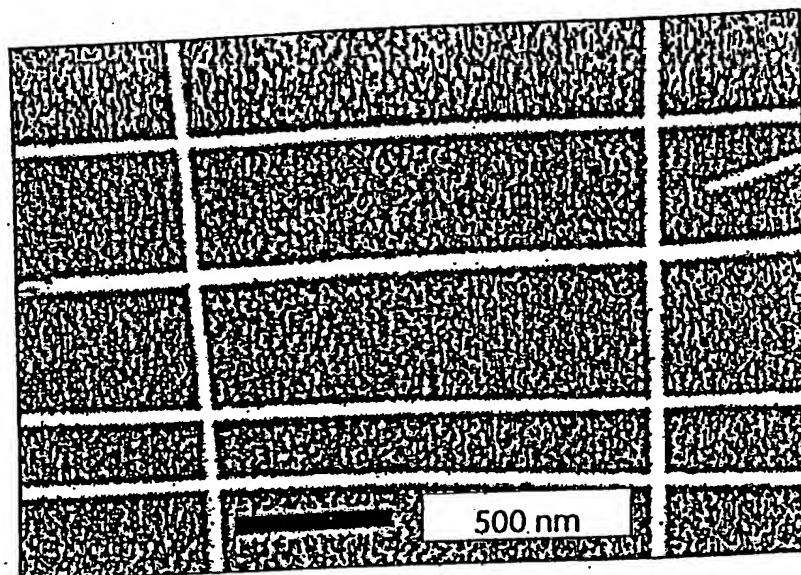


Fig. 7E

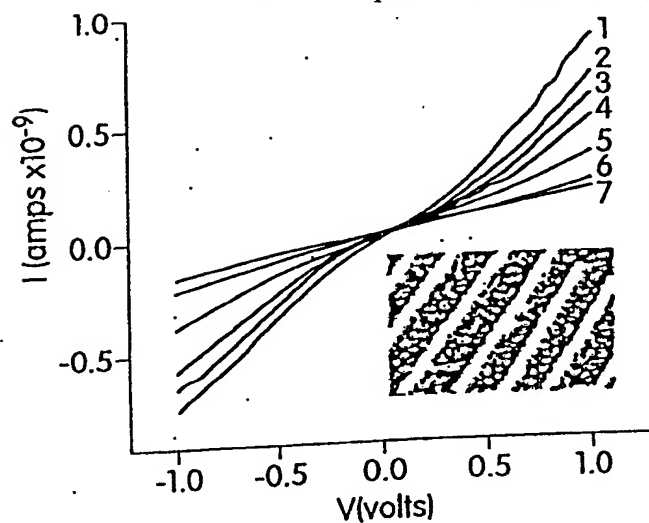


Fig. 8A

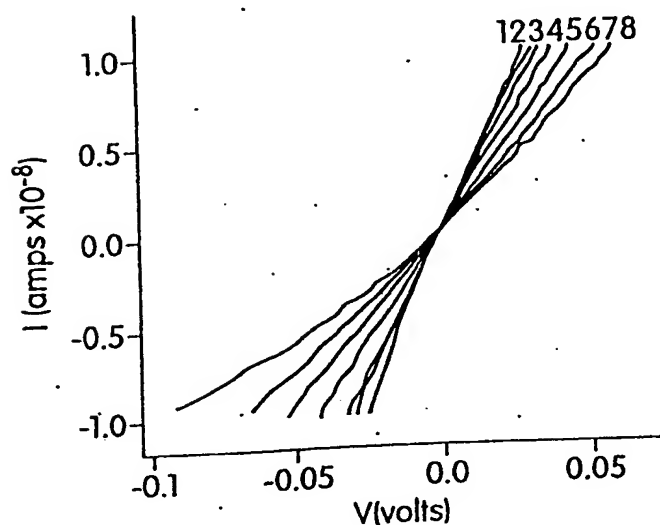


Fig. 8B

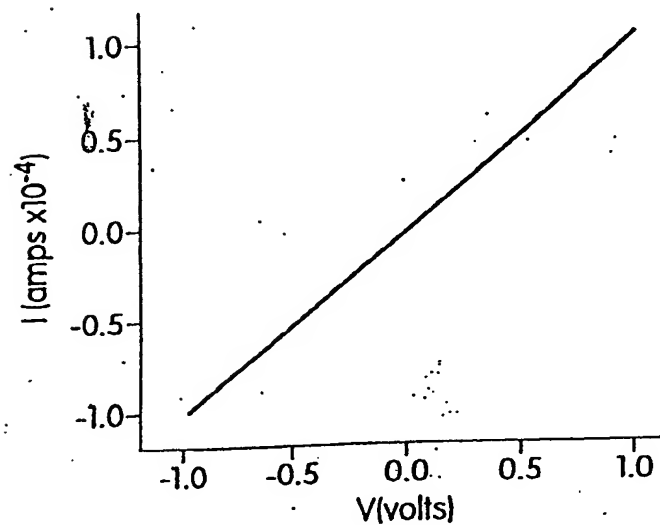


Fig. 8C

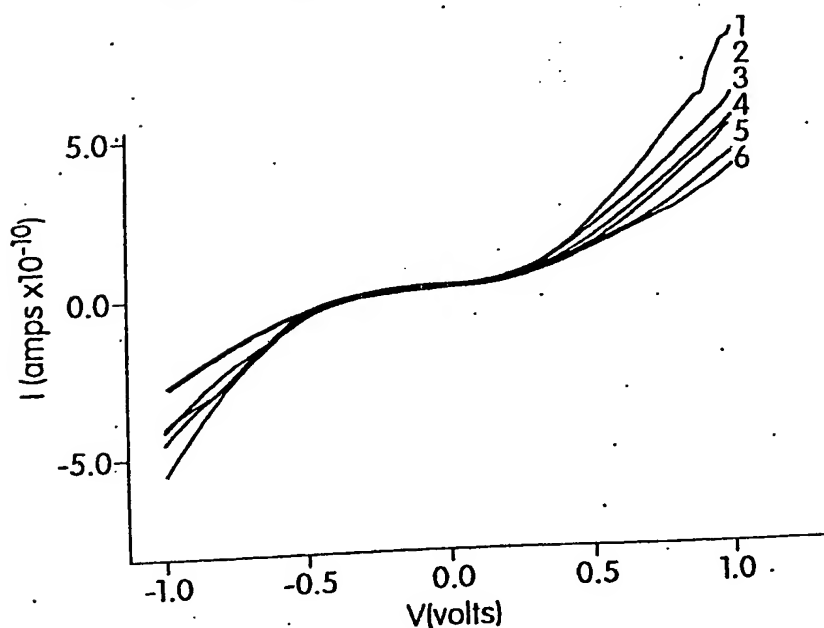


Fig. 9A

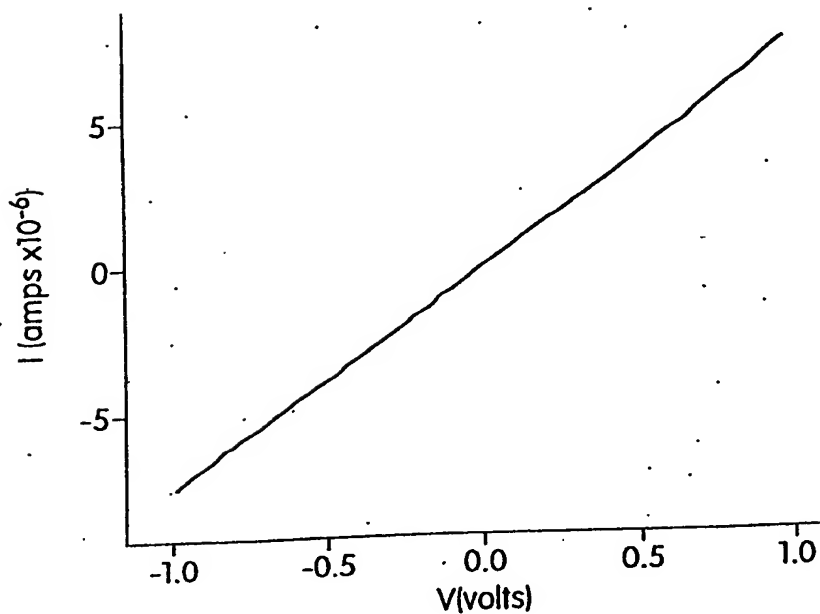


Fig. 9B

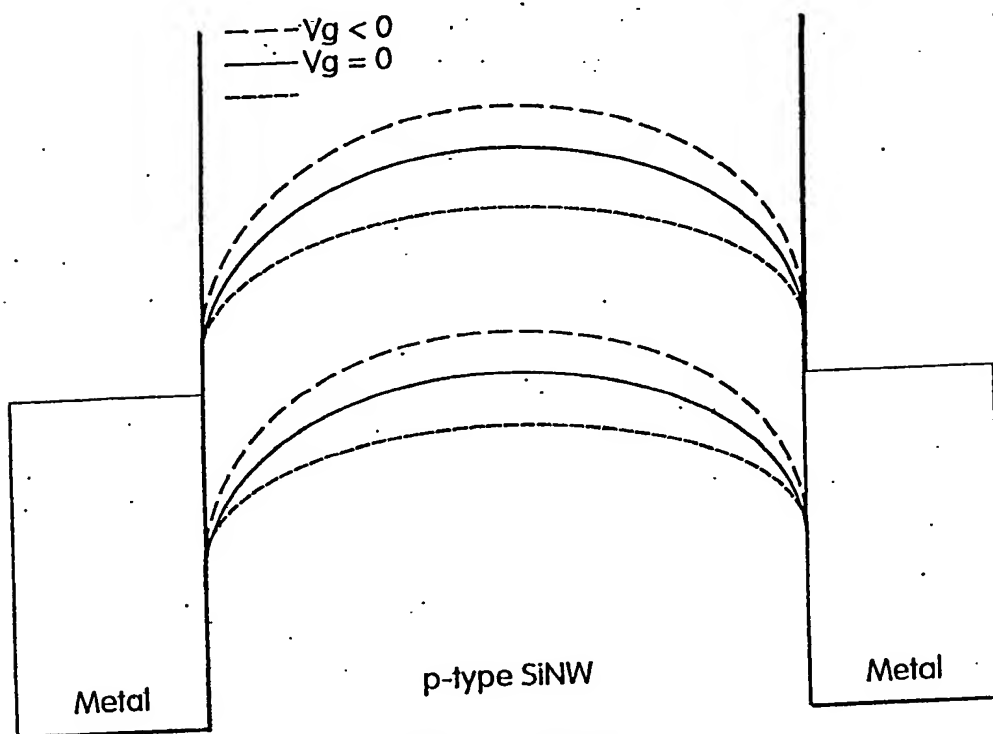


Fig. 10A

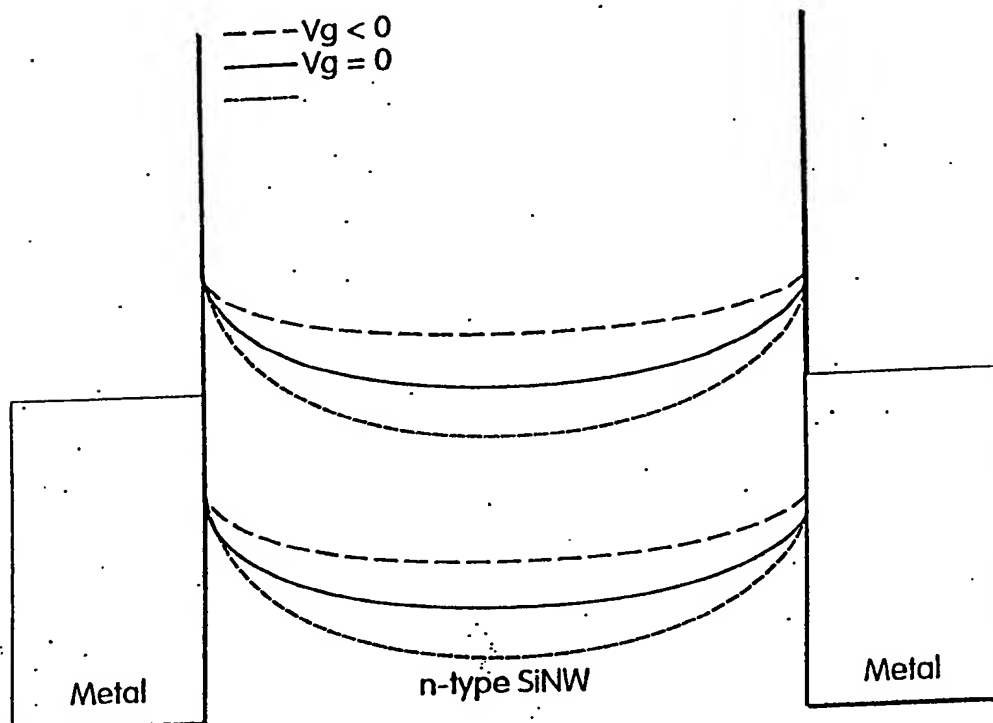


Fig. 10B

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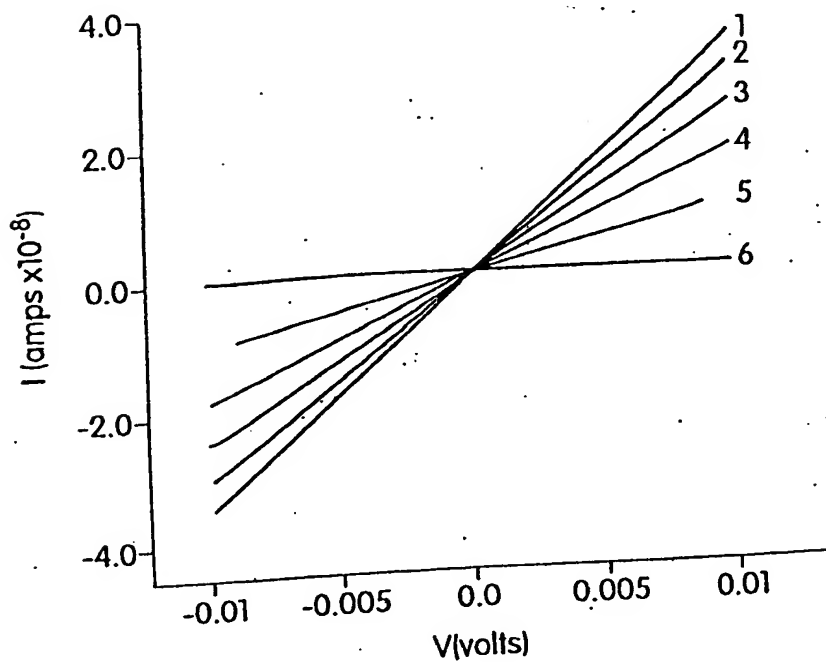


Fig. 11A

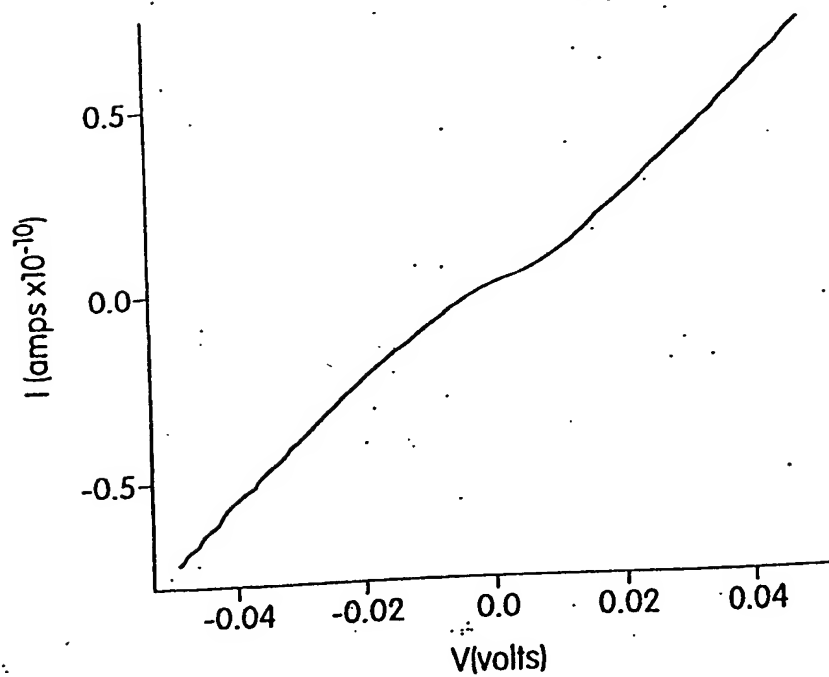


Fig. 11B

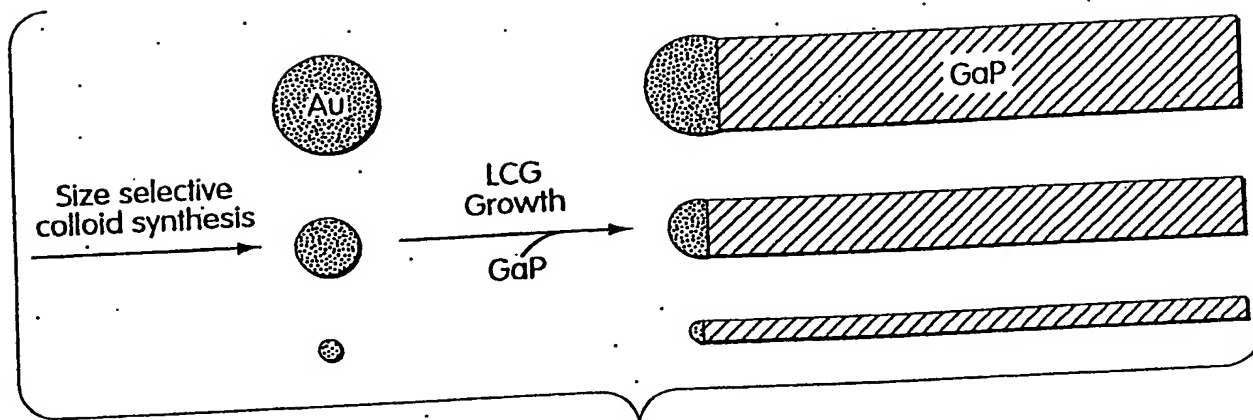


Fig. 12

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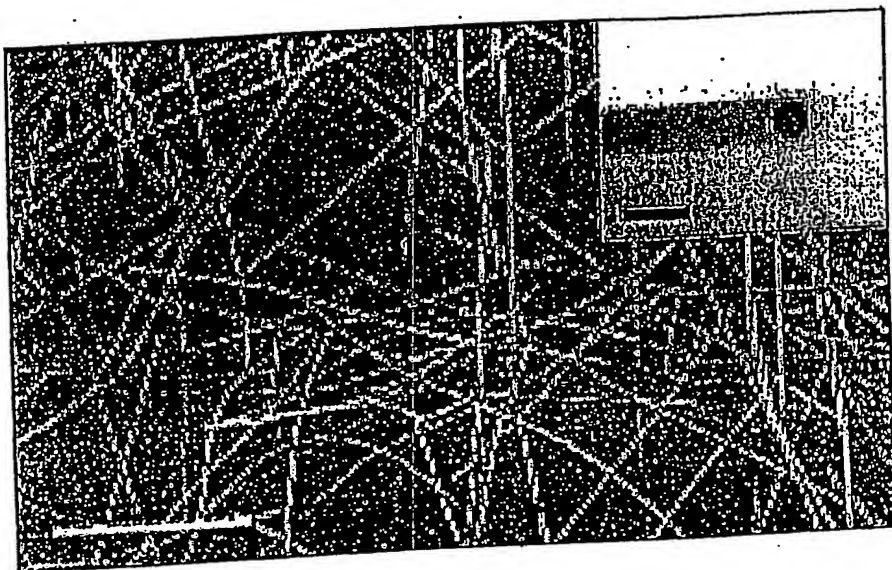


Fig. 13A

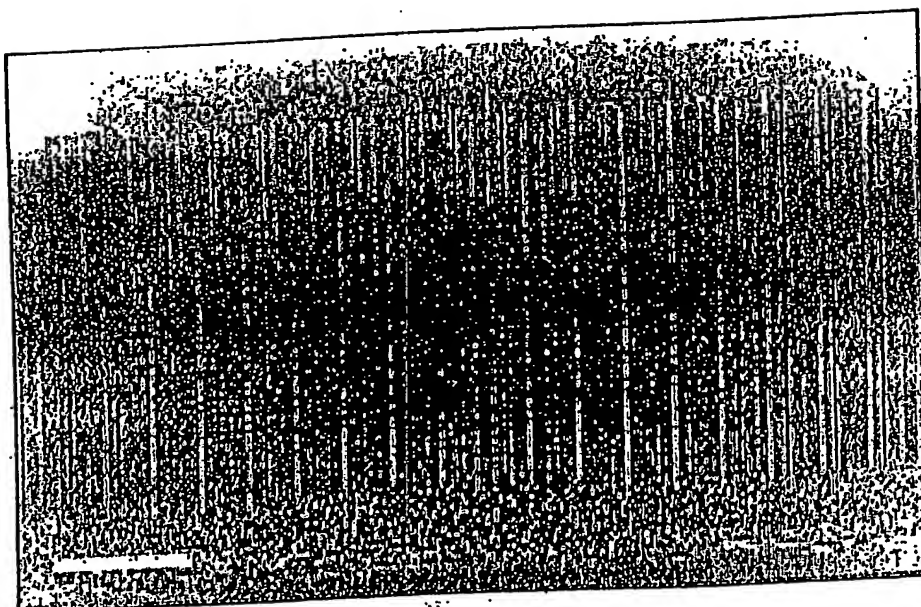


Fig. 13B

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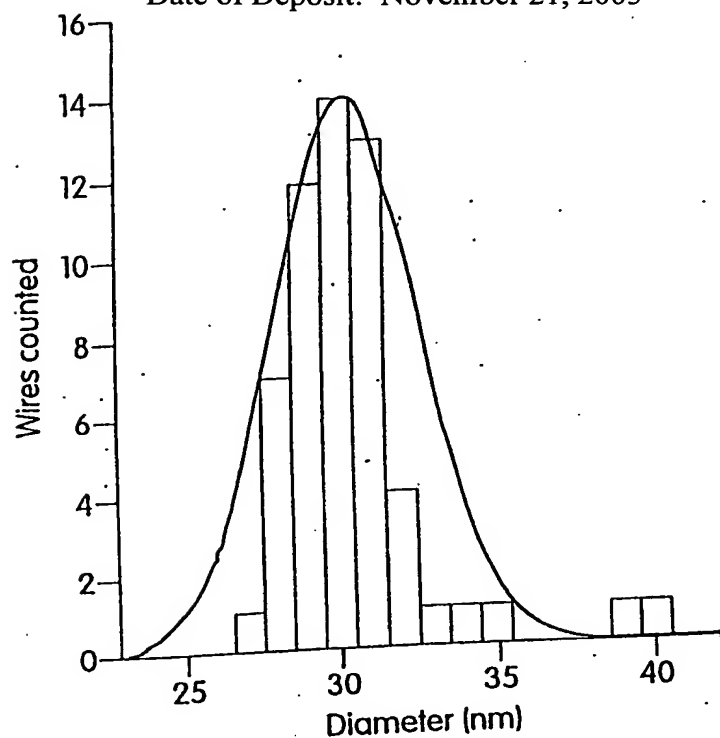


Fig. 14A

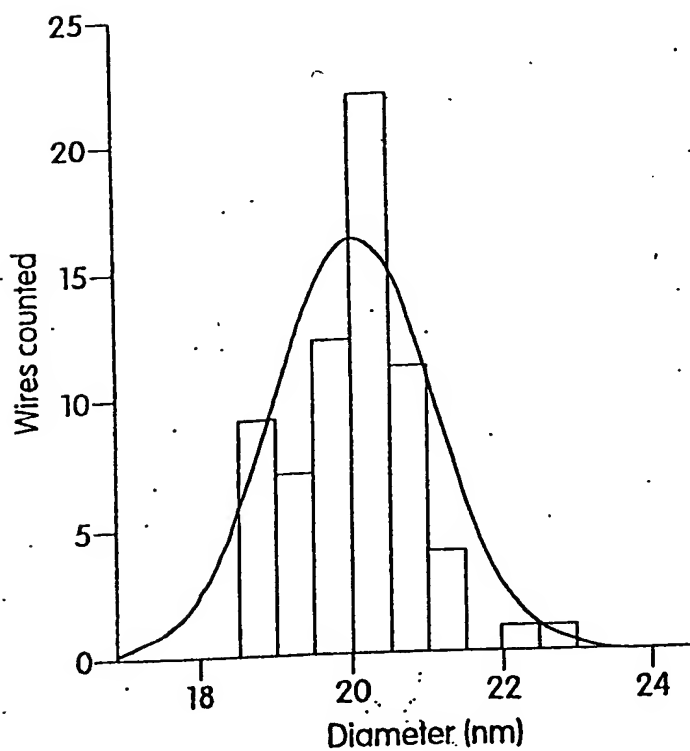


Fig. 14B

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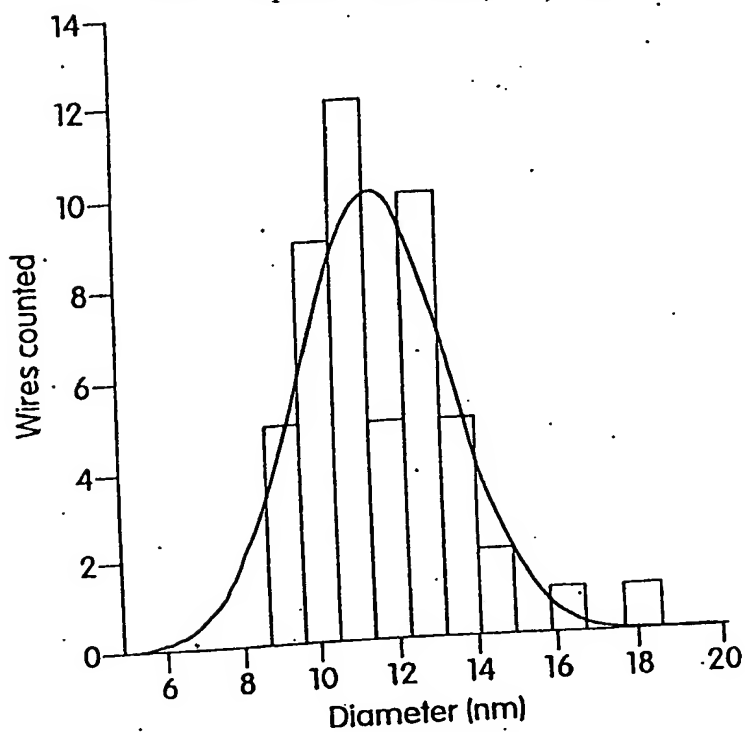


Fig. 14C

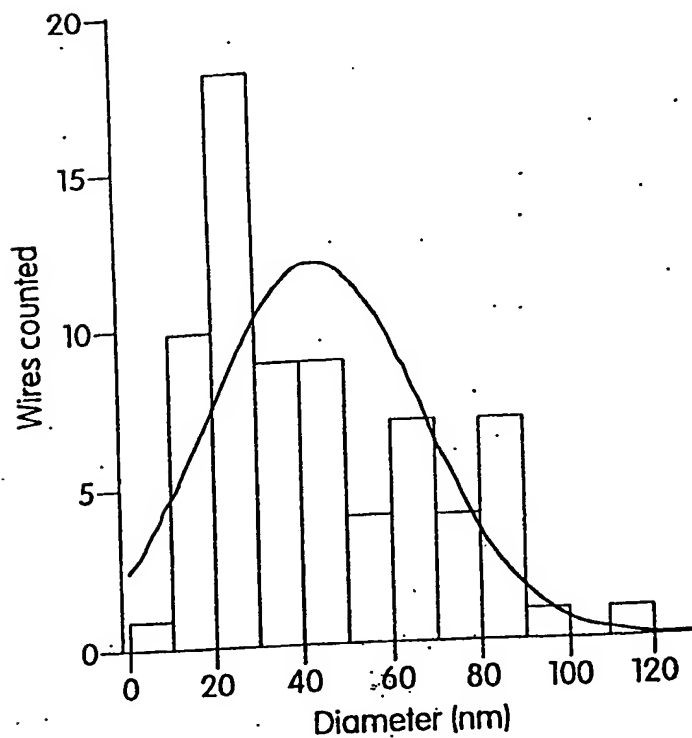


Fig. 14D

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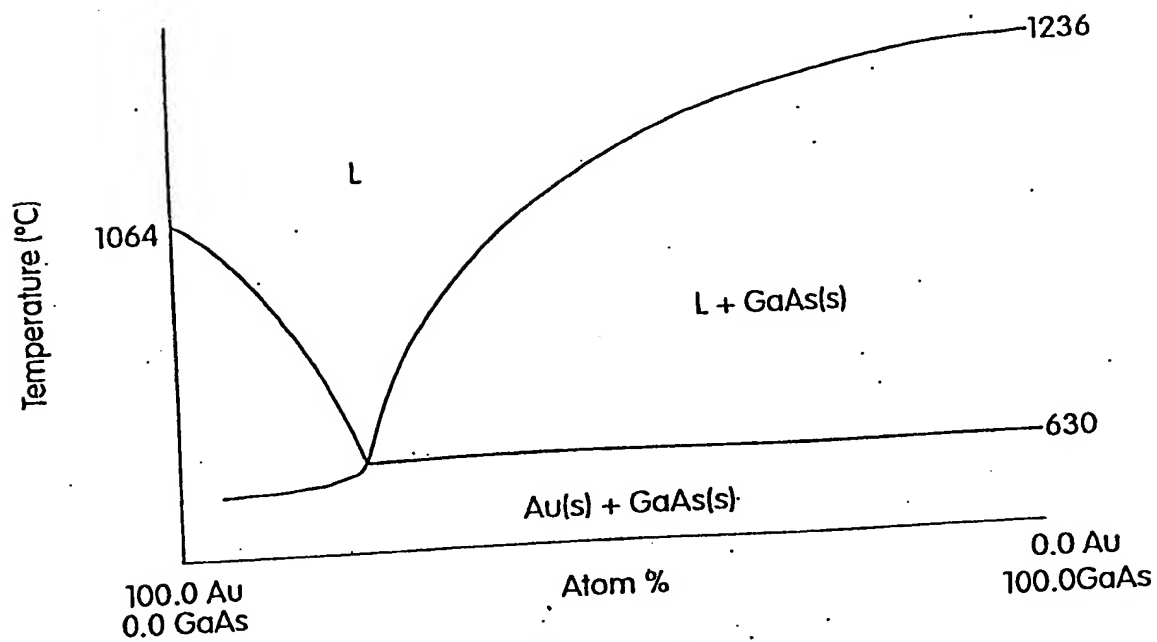


Fig. 15

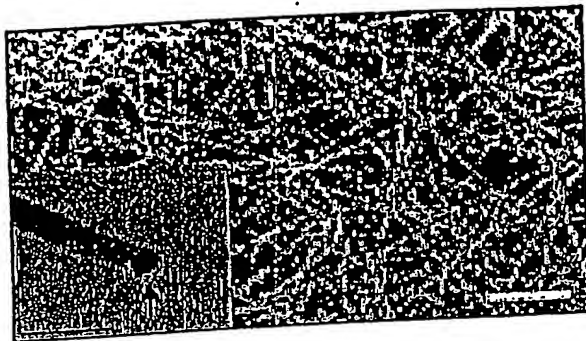


Fig. 16A

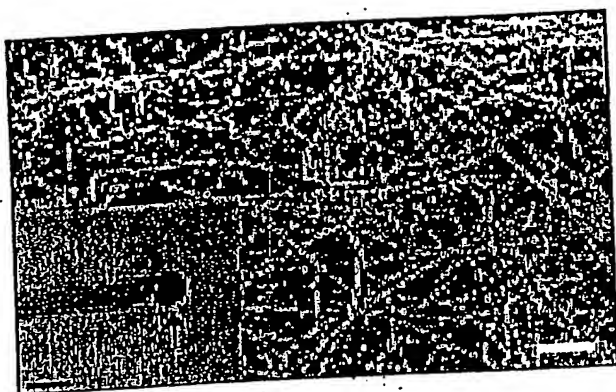


Fig. 16B



Fig. 16C

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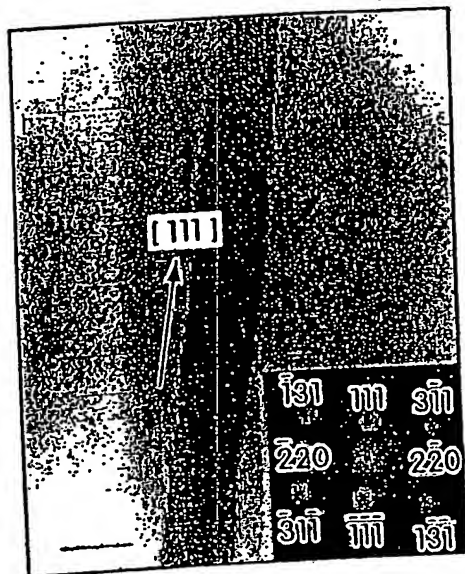


Fig. 17A

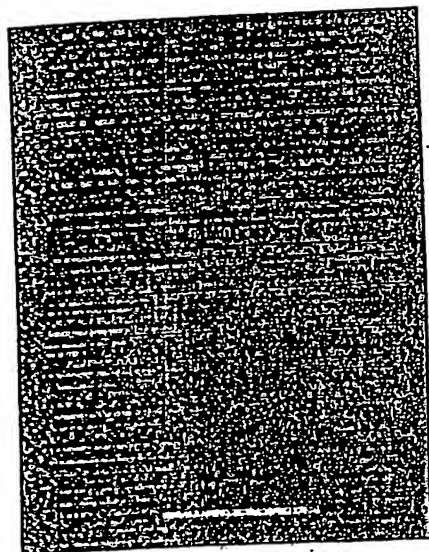


Fig. 17B

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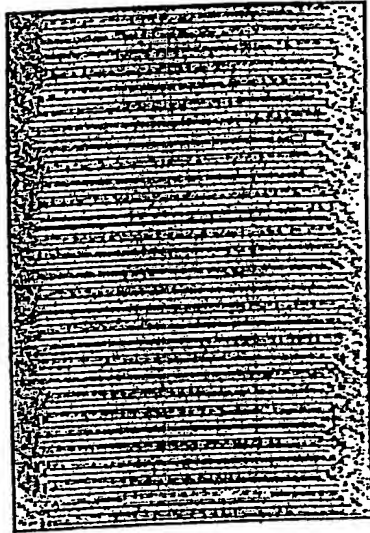


Fig. 17C



Fig. 17D

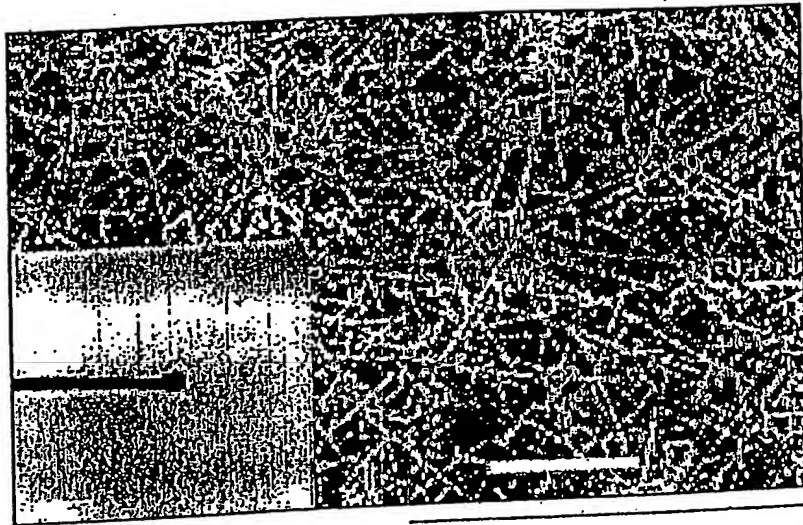


Fig. 18A

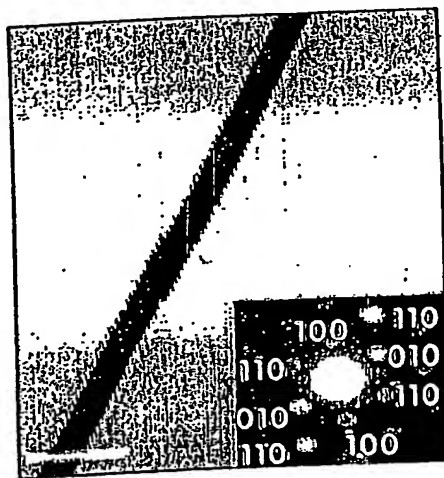


Fig. 18B

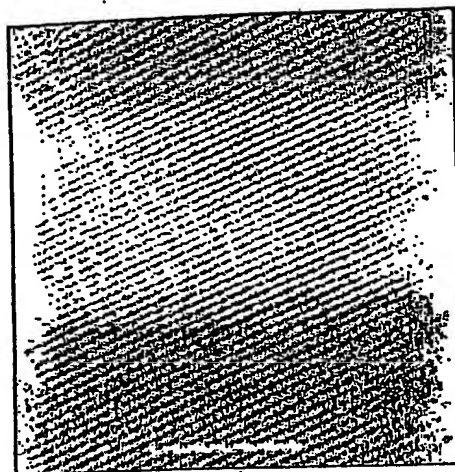


Fig. 18C

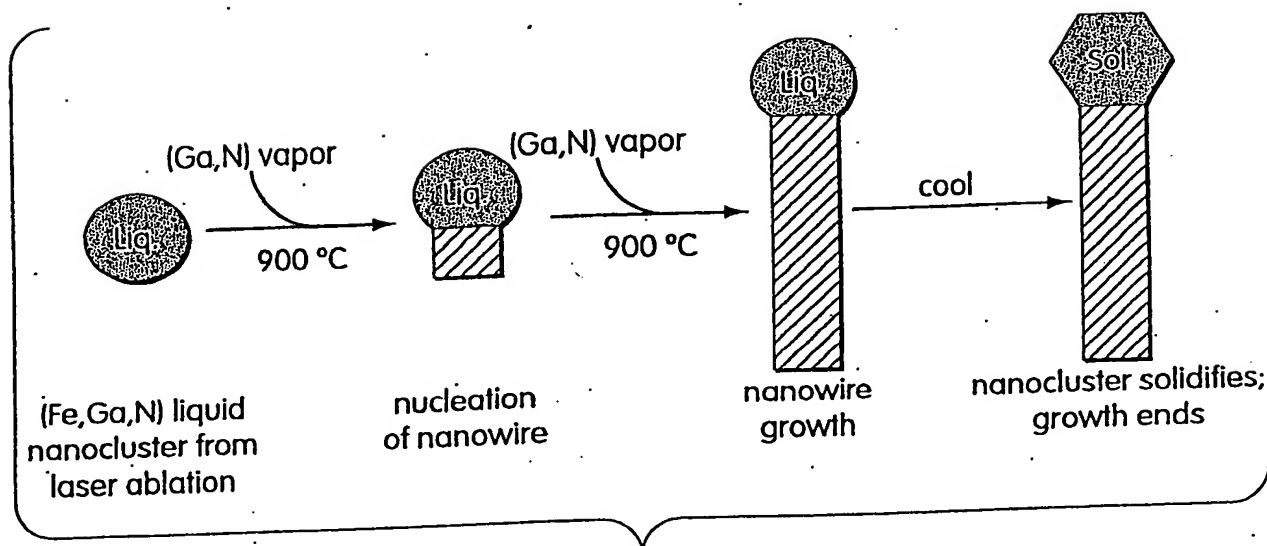


Fig. 19

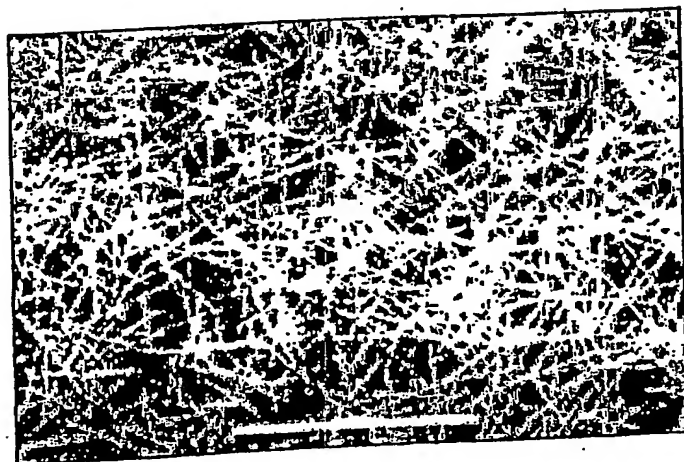


Fig. 20A

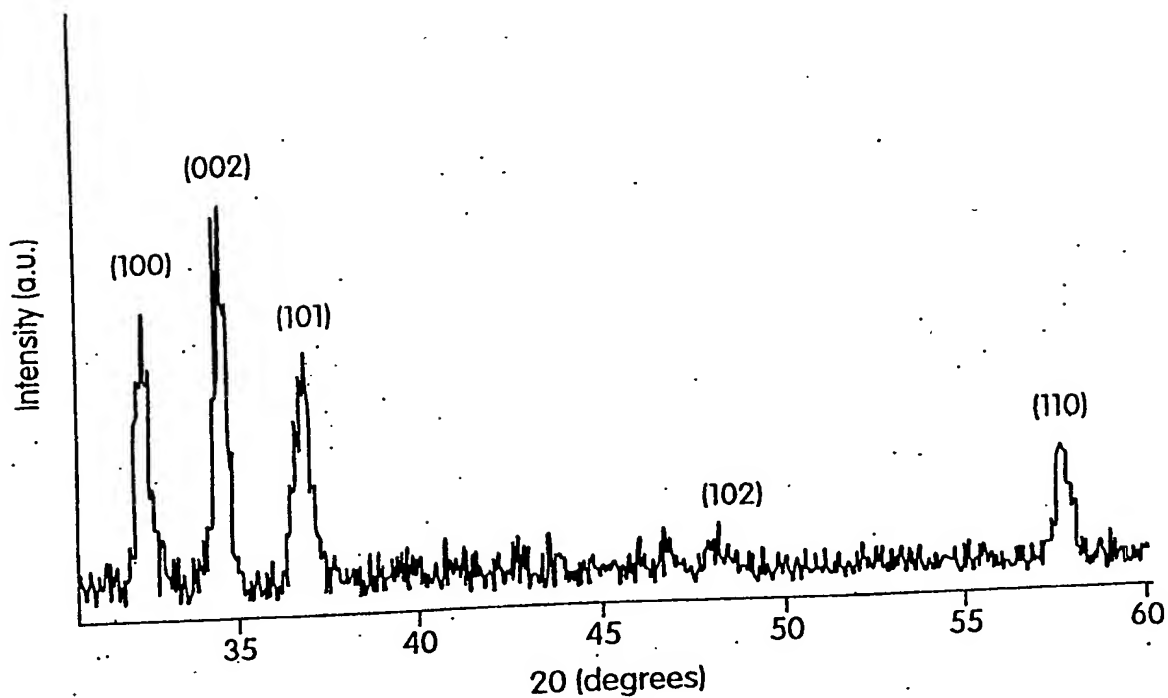


Fig. 20B

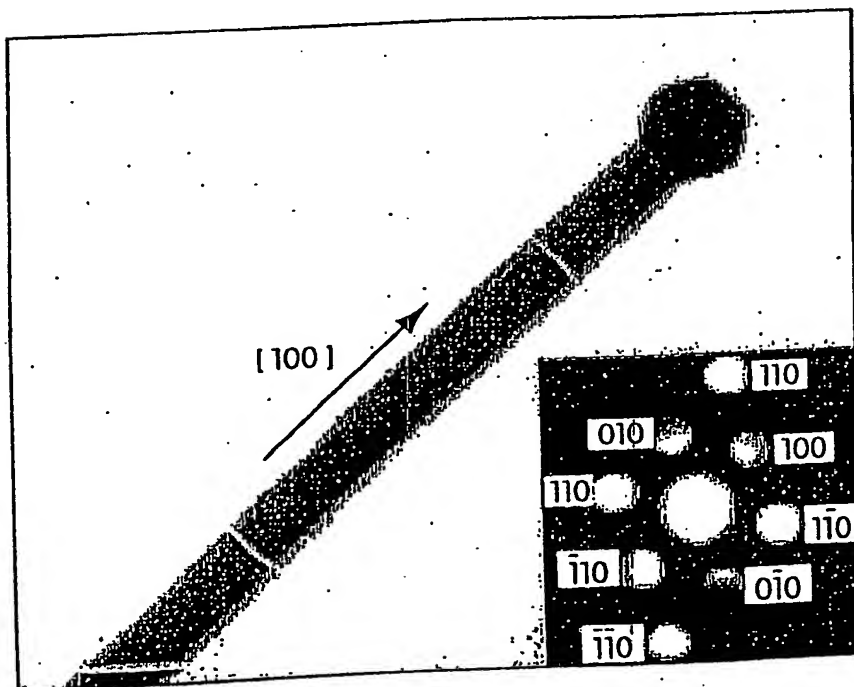


Fig. 21A

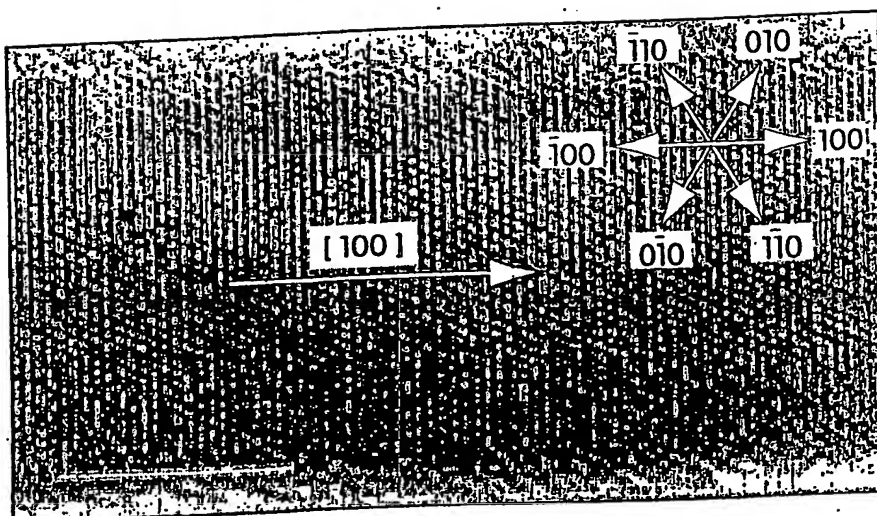


Fig. 21B

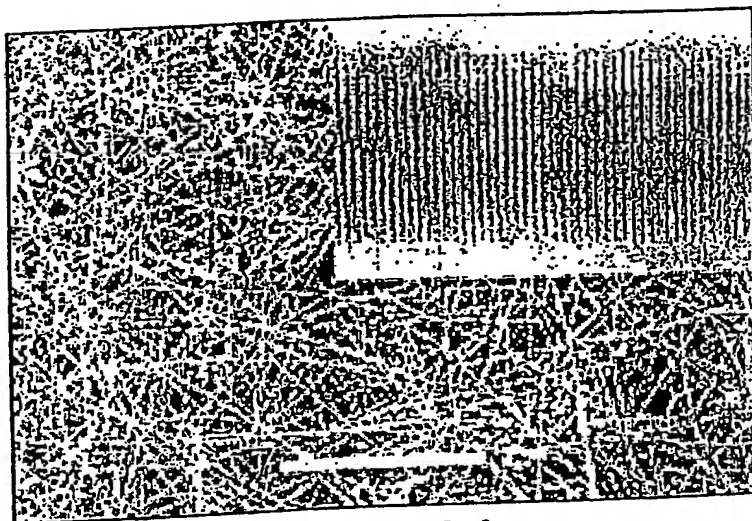


Fig. 22A

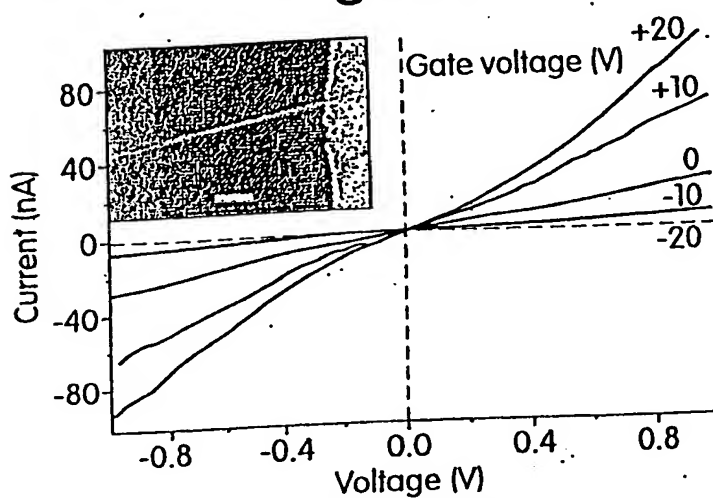


Fig. 22B

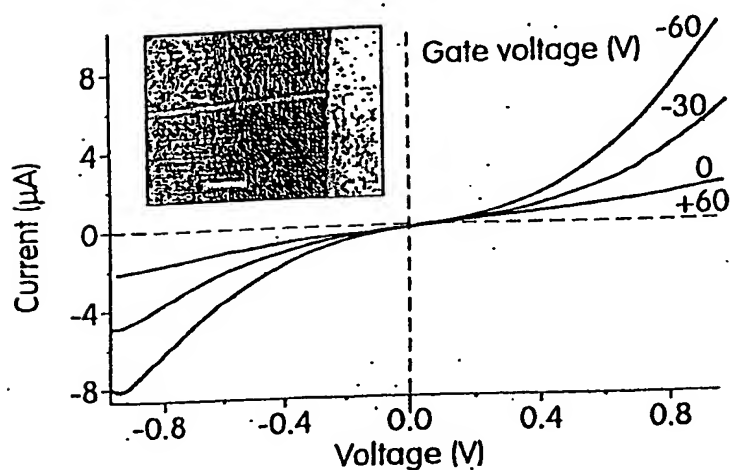


Fig. 22C

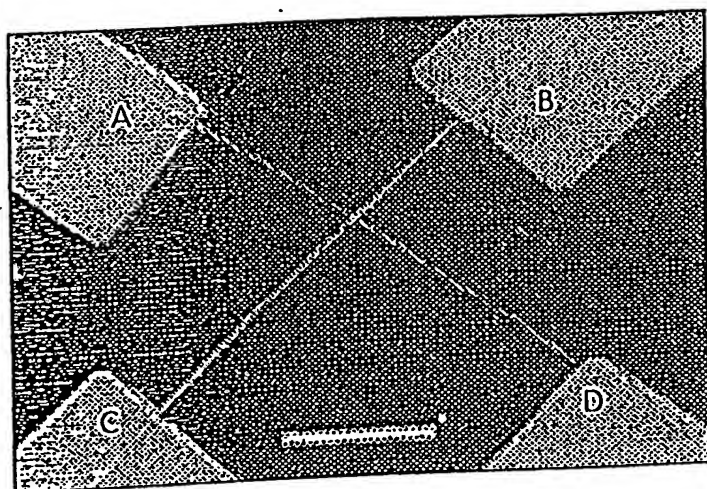


Fig. 23A

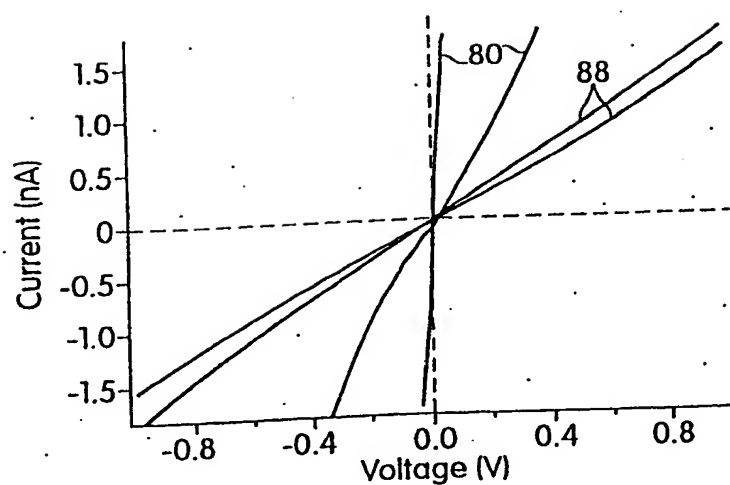


Fig. 23B

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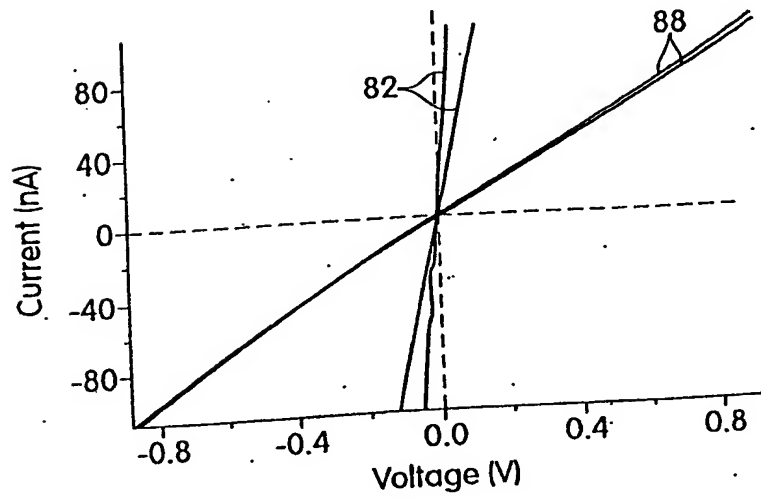


Fig. 23C

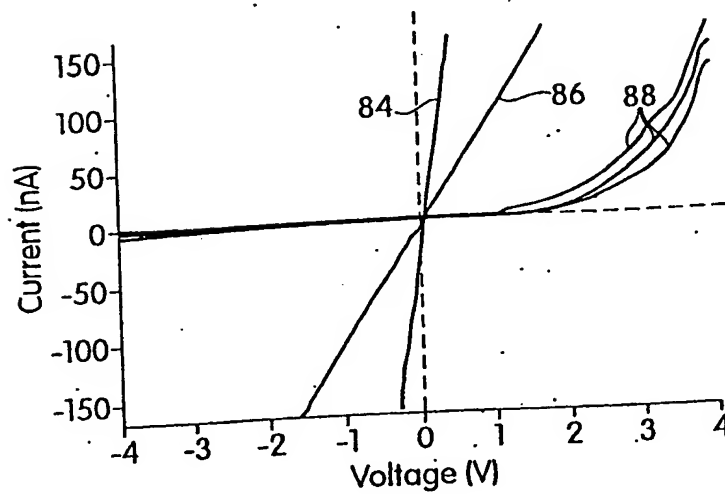


Fig. 23D

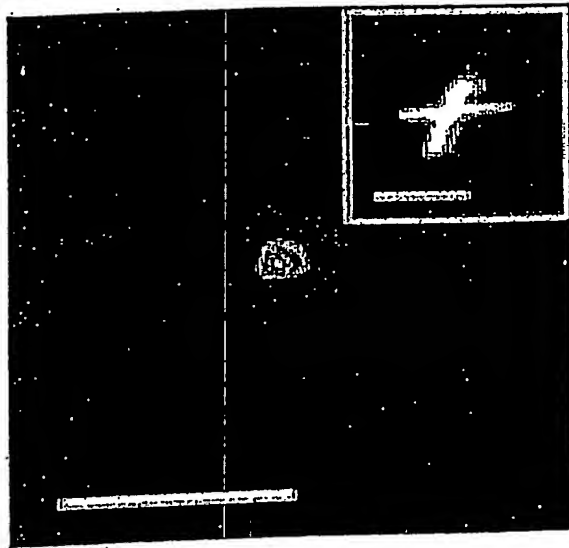


Fig. 24A

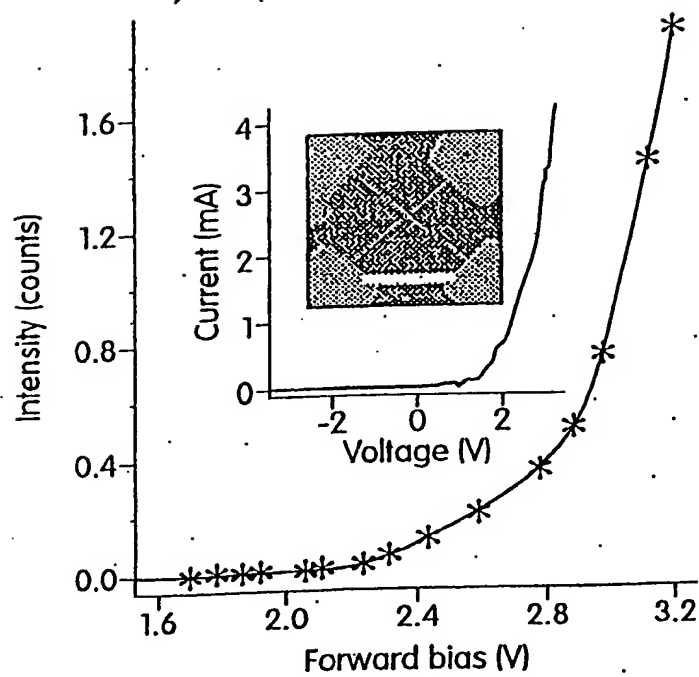


Fig. 24B

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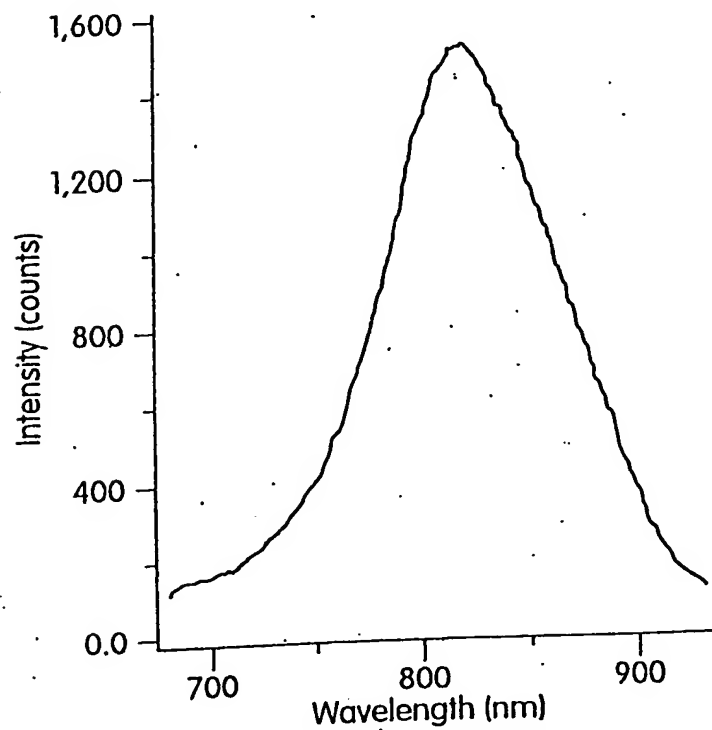


Fig. 24C

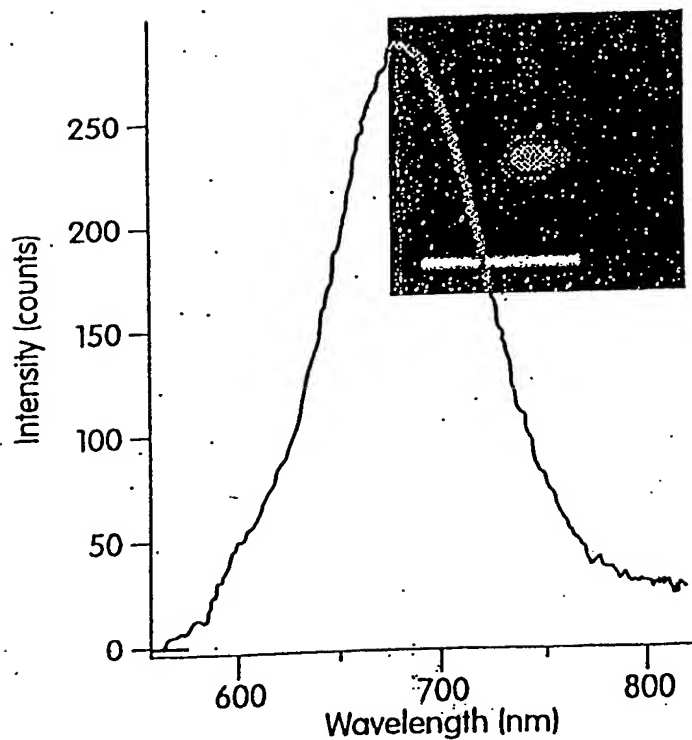


Fig. 24D

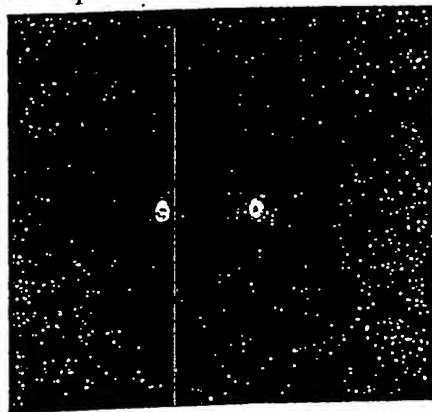


Fig. 25A

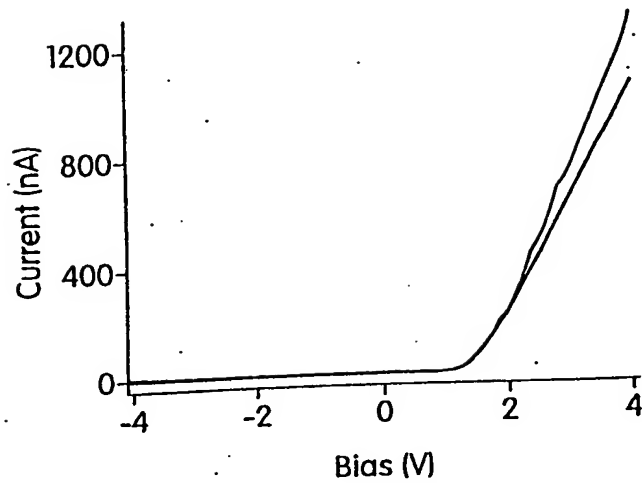


Fig. 25B

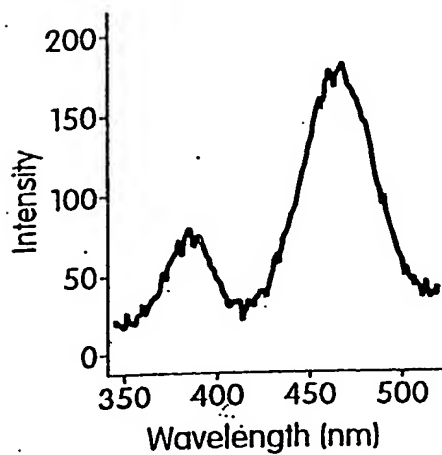


Fig. 25C

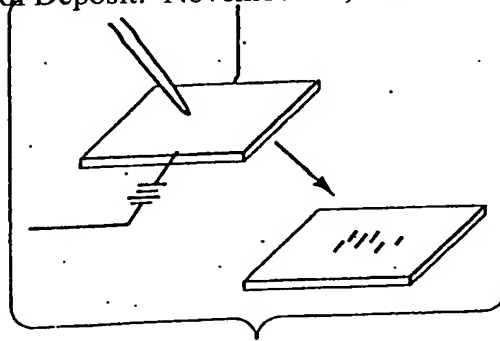


Fig. 26A

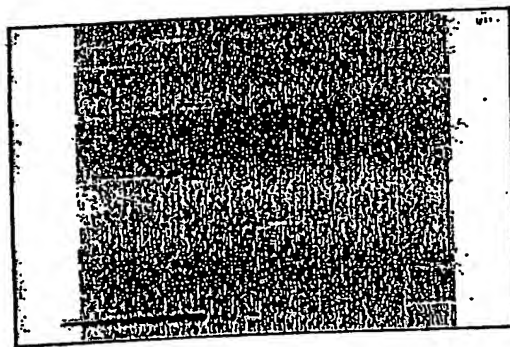


Fig. 26B

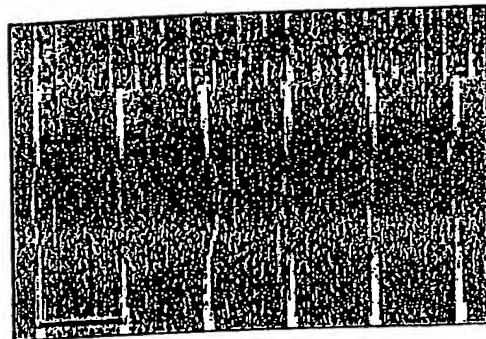


Fig. 26C

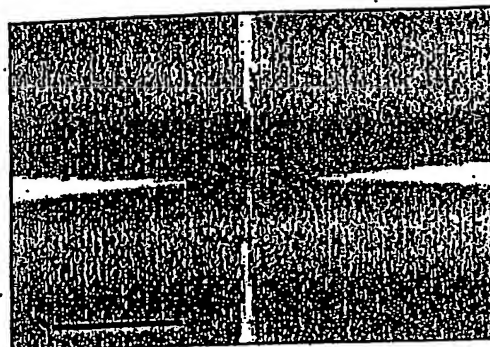


Fig. 26D

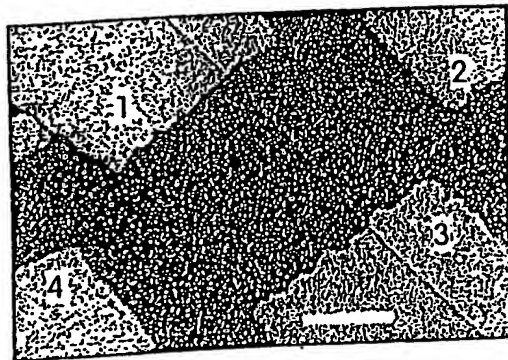


Fig. 27A

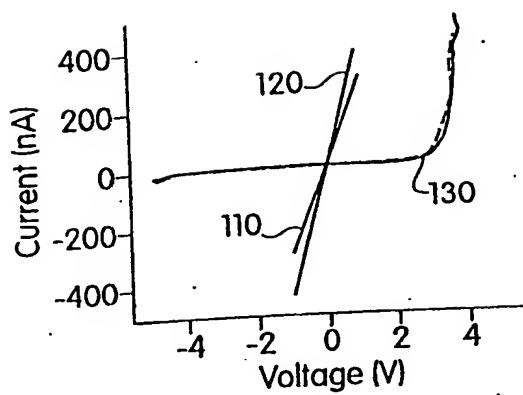


Fig. 27B

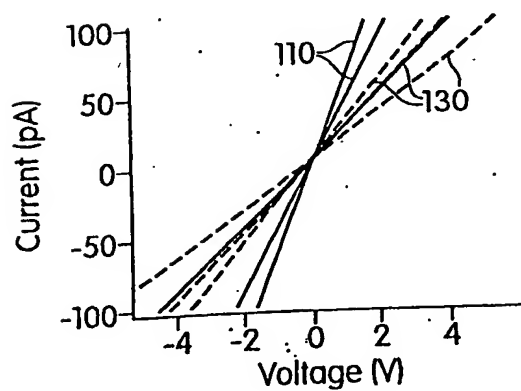


Fig. 27C

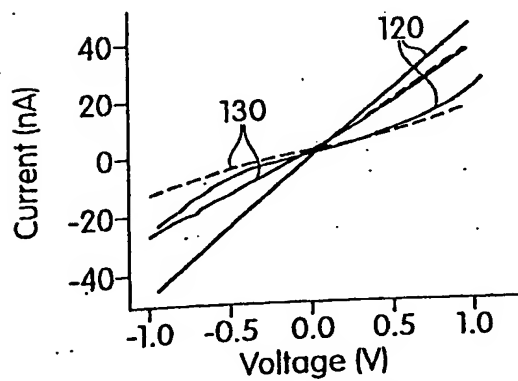
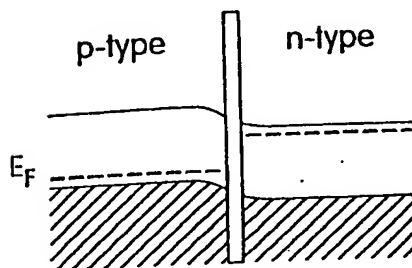
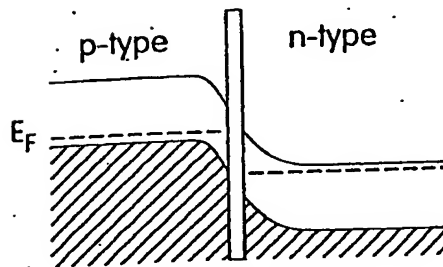


Fig. 27D



Forward bias

Fig. 27E



Reverse bias

Fig. 27F

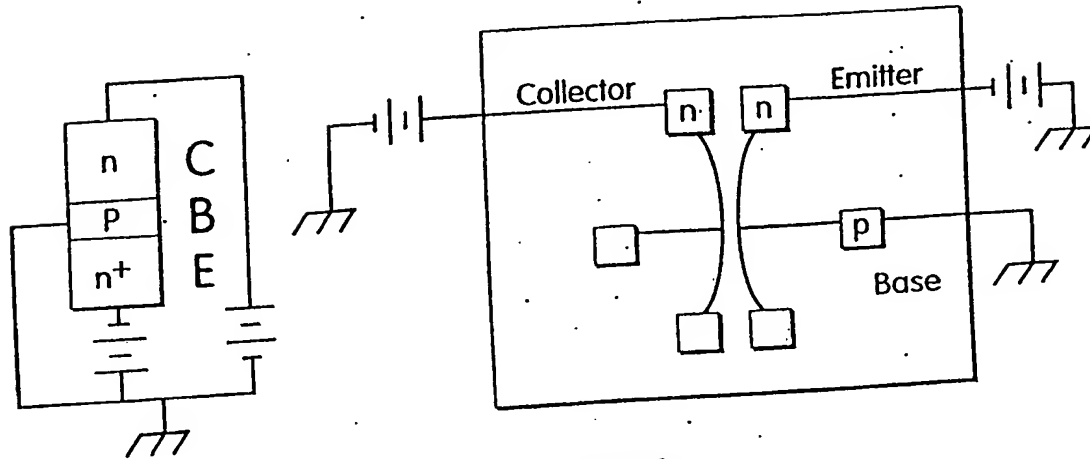


Fig. 28A

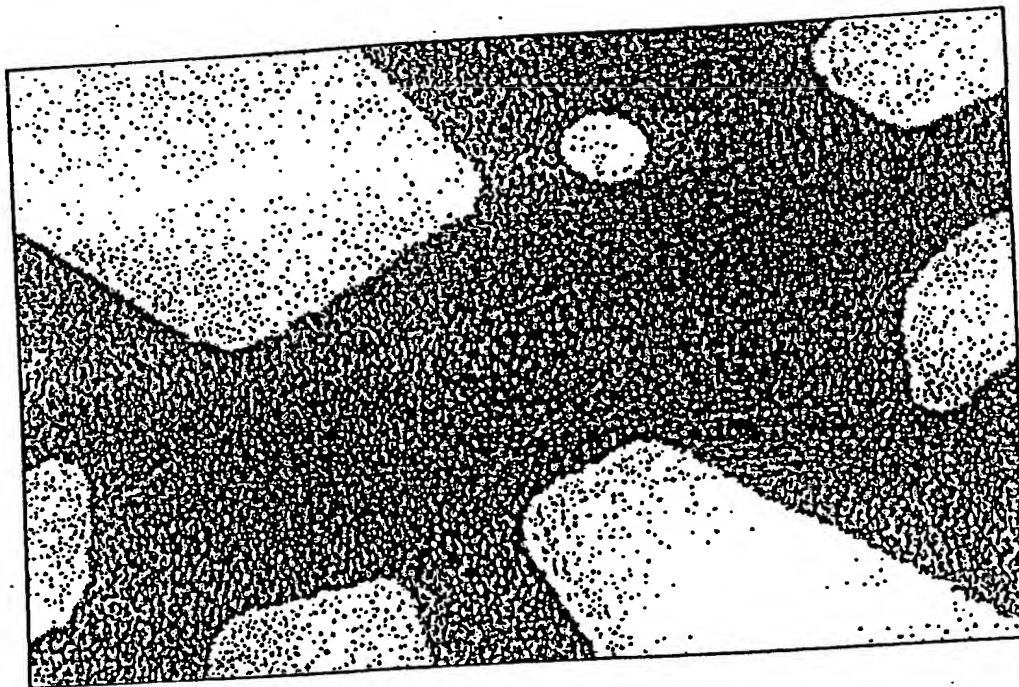


Fig. 28B

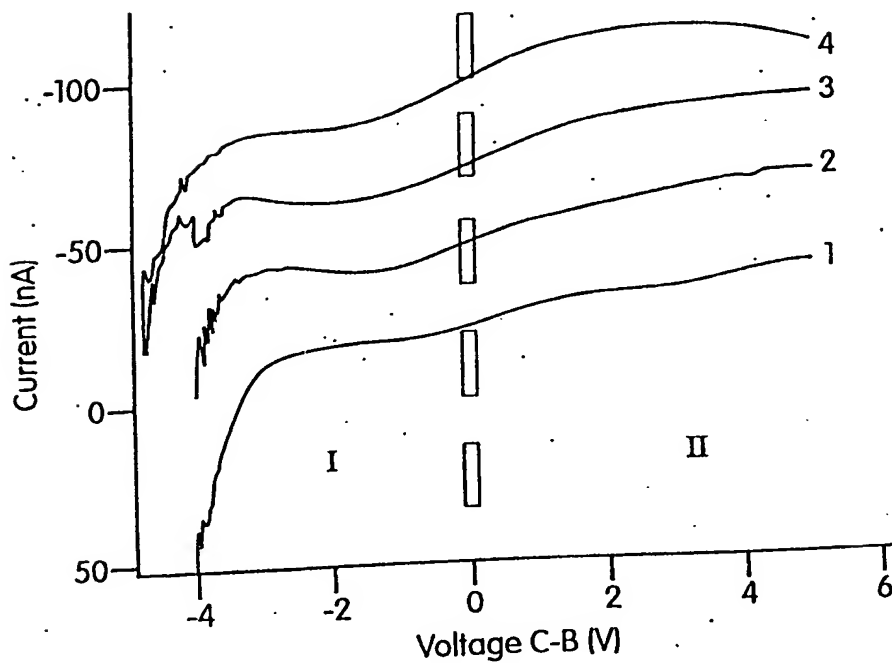


Fig. 28C

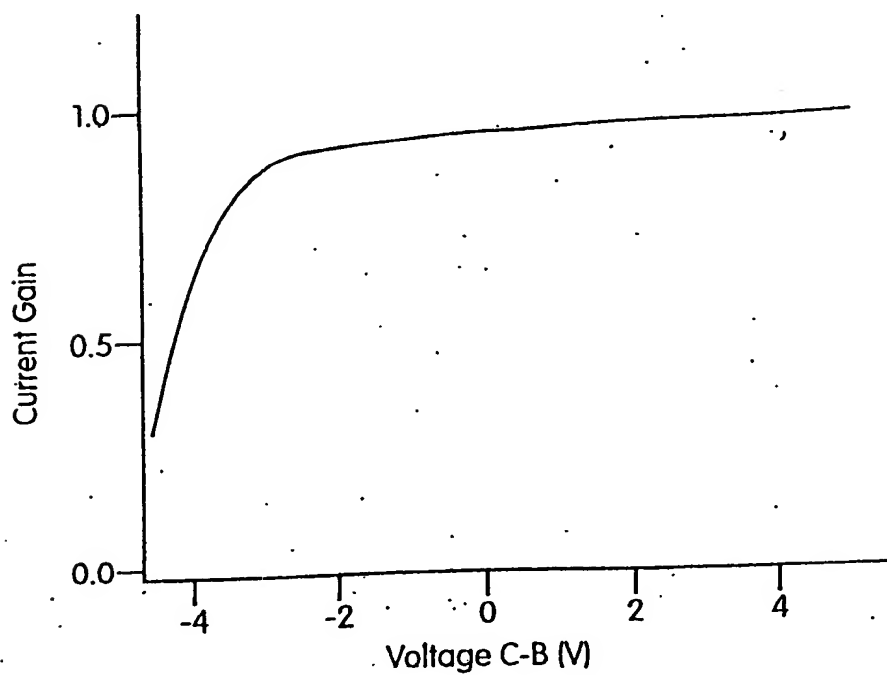


Fig. 28D

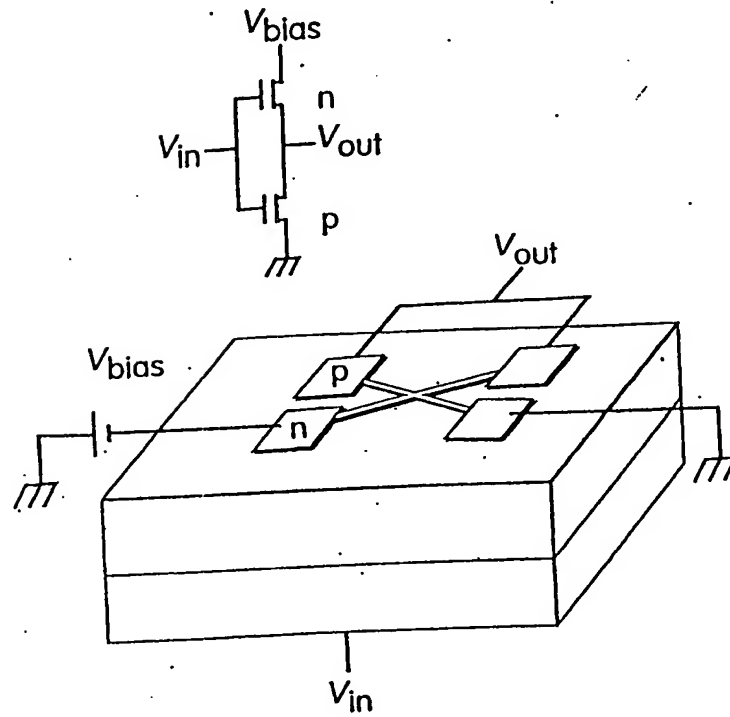


Fig. 29A

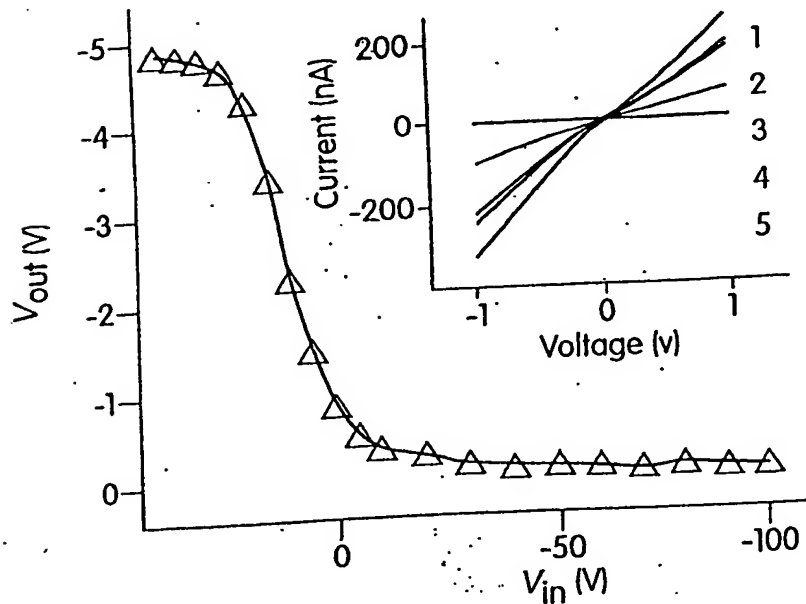


Fig. 29B

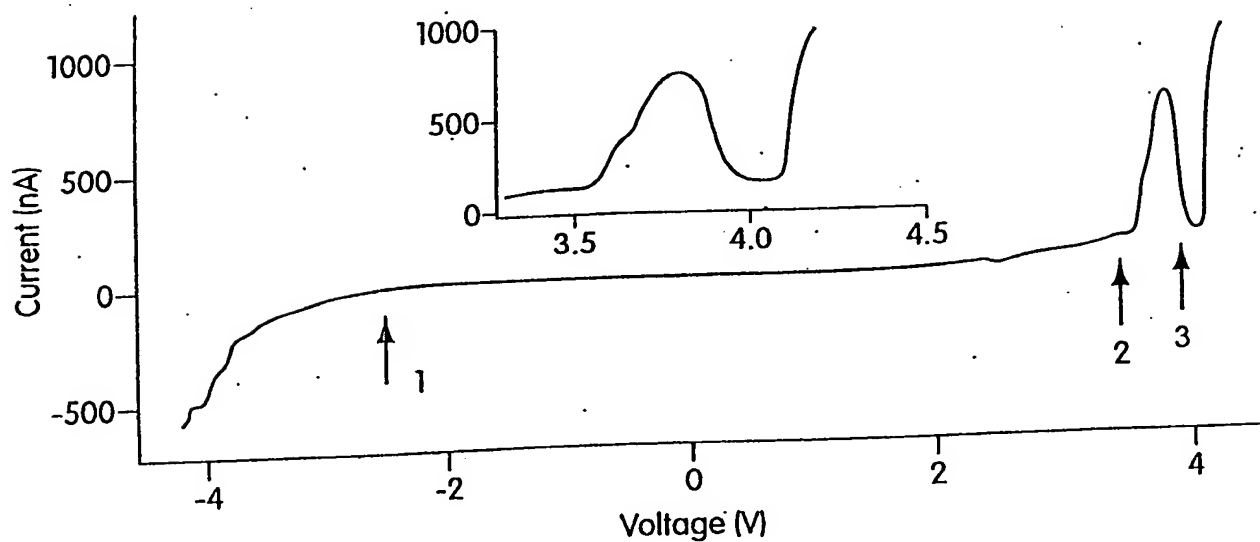


Fig. 29C

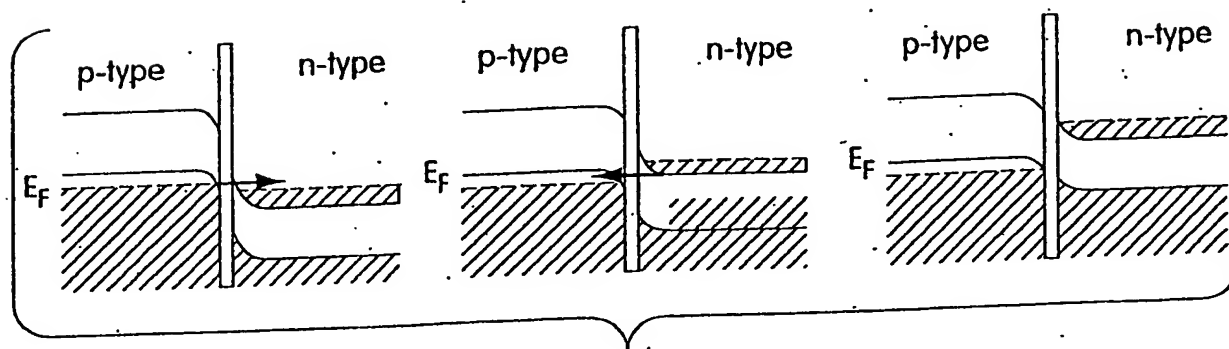
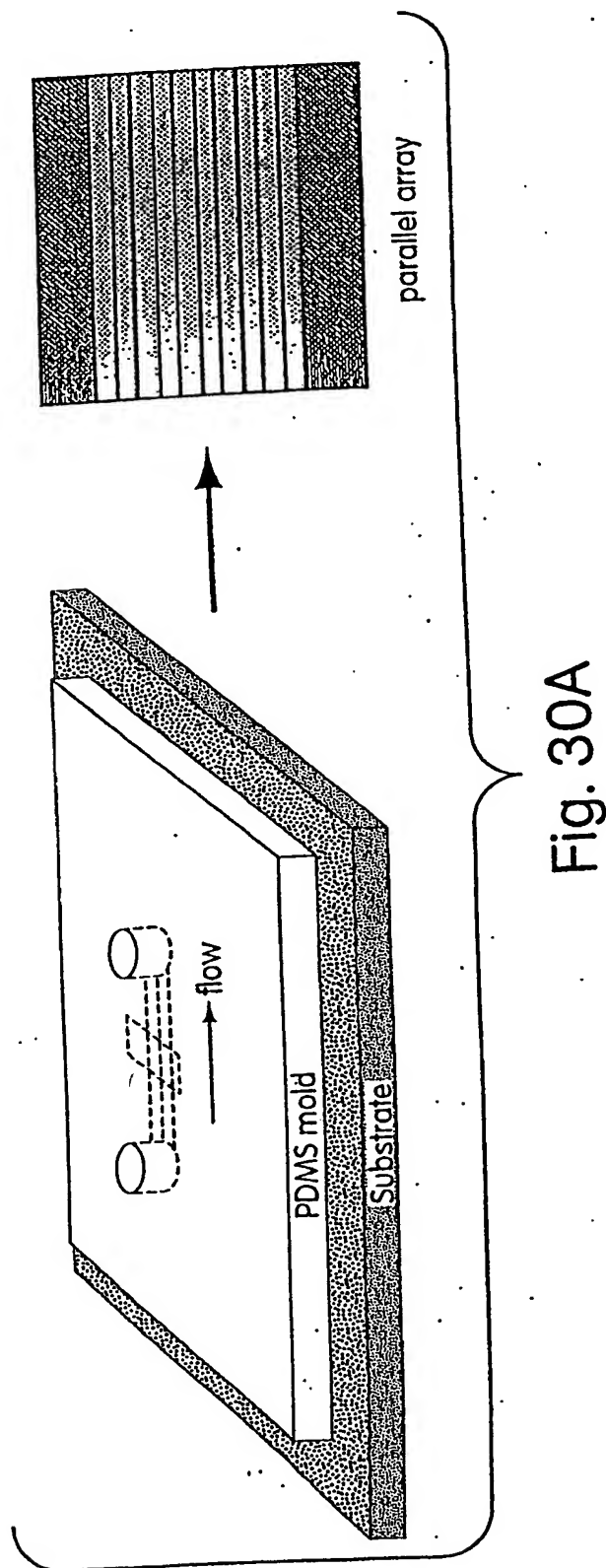


Fig. 29D



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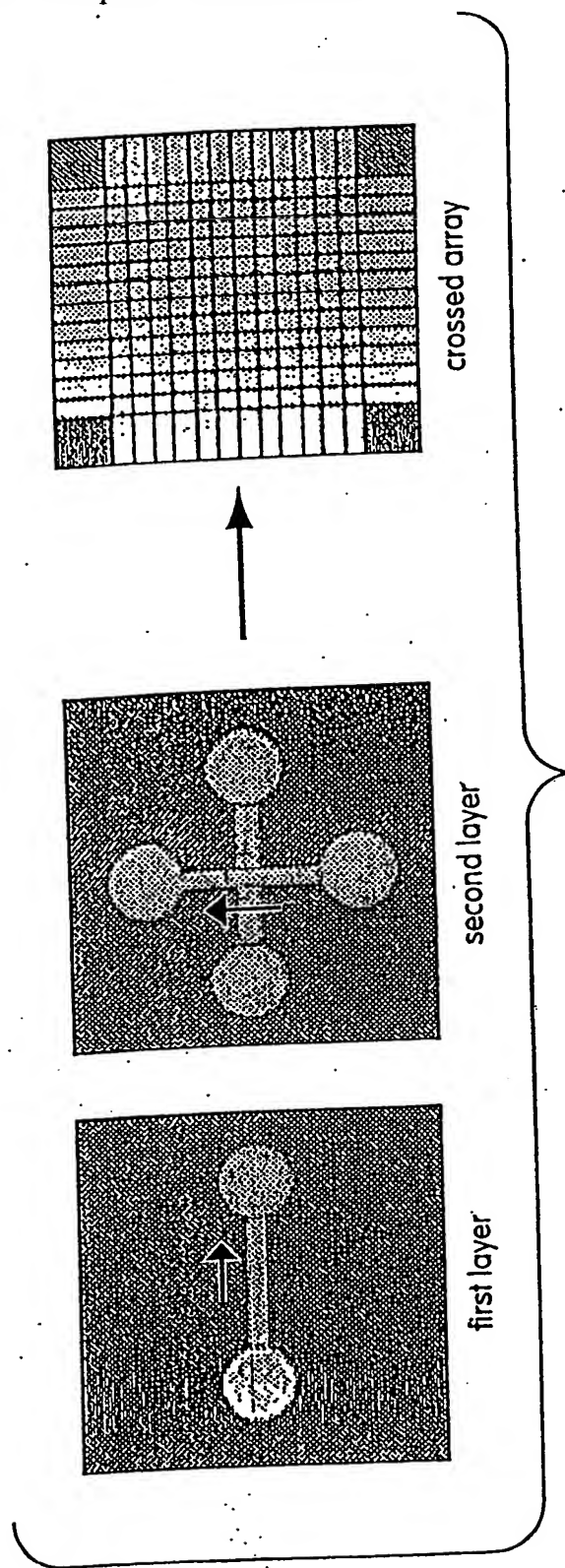


Fig. 30B

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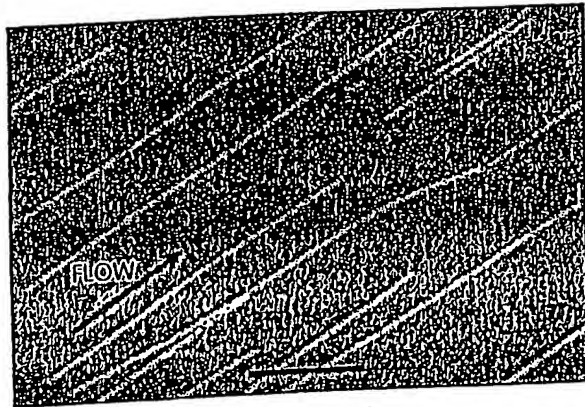


Fig. 31A

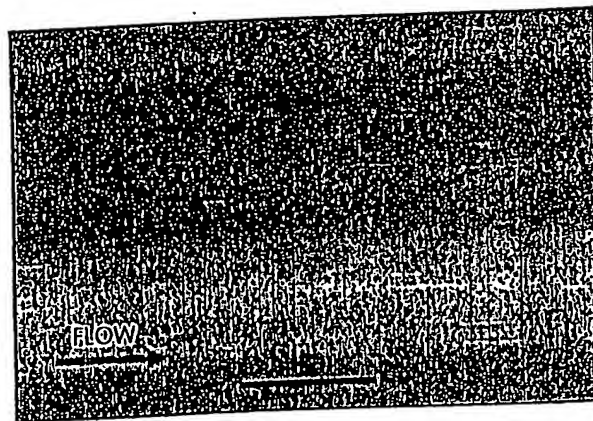


Fig. 31B

H0498.70187US01

NANOSCALE WIRES AND RELATED DEVICES

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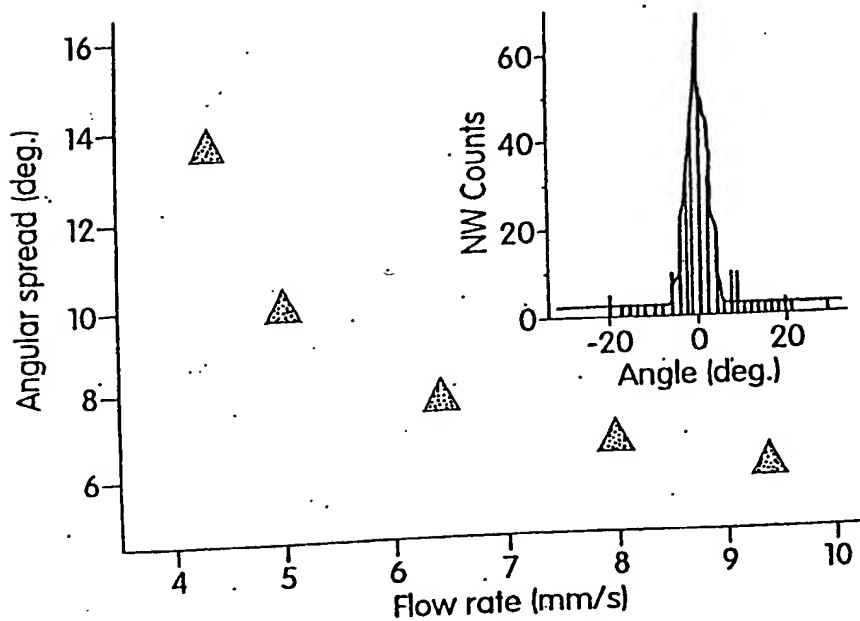


Fig. 31C

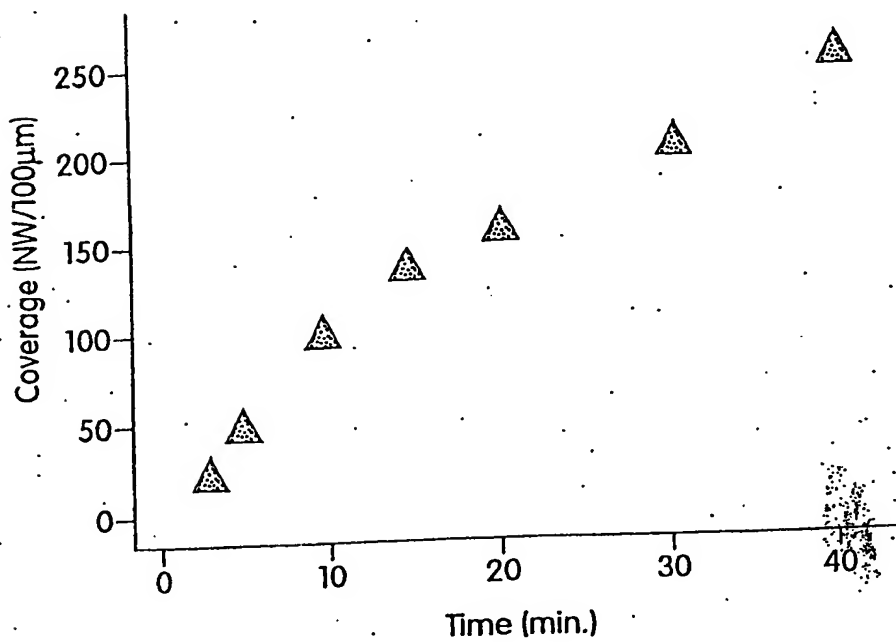


Fig. 31D

H0498.70187US01
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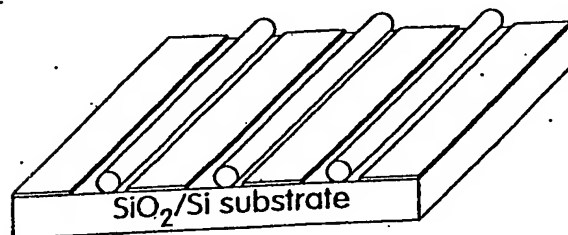


Fig. 32A

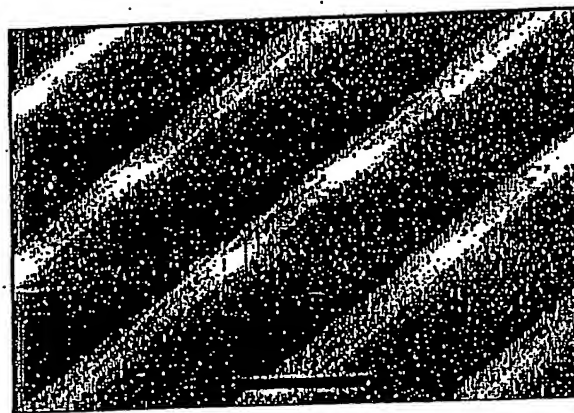


Fig. 32B

H0498.70187US01

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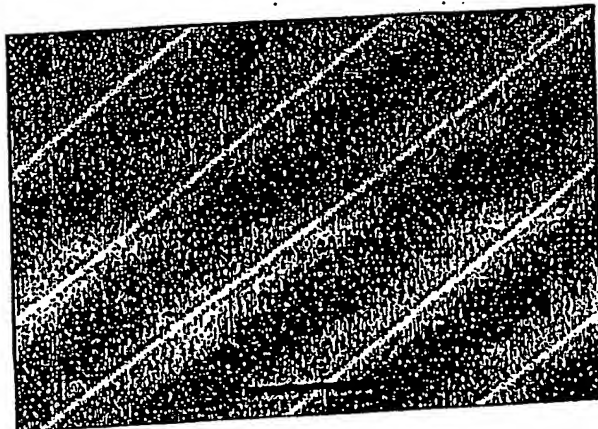


Fig. 32C

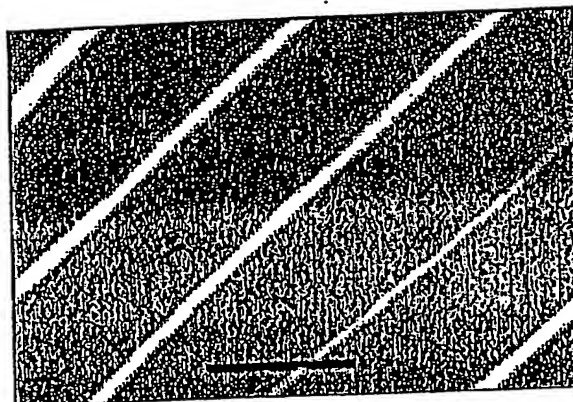


Fig. 32D

H0498.70187US01

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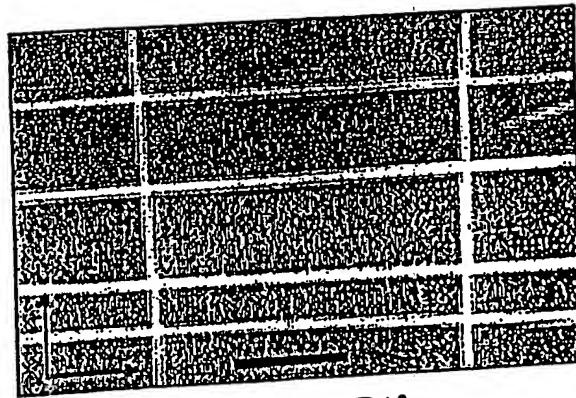


Fig. 33A

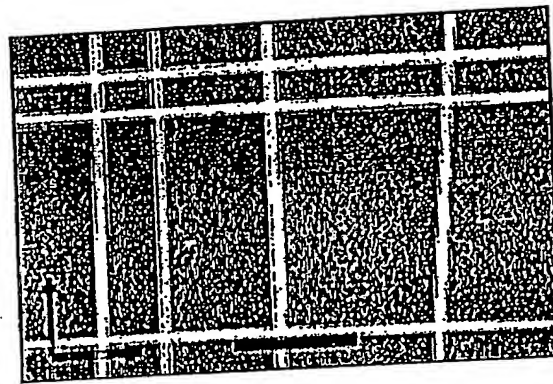


Fig. 33B

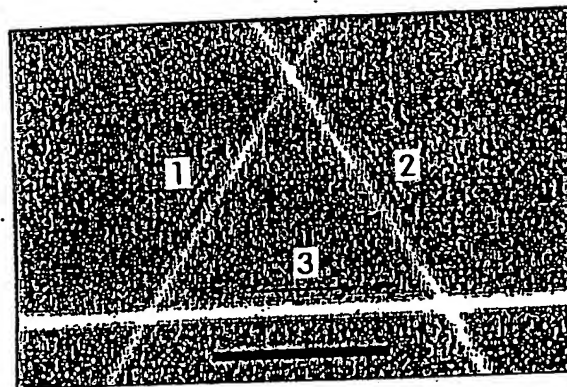


Fig. 33C

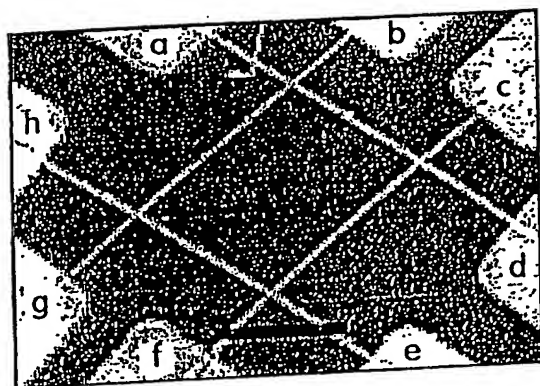


Fig. 33D

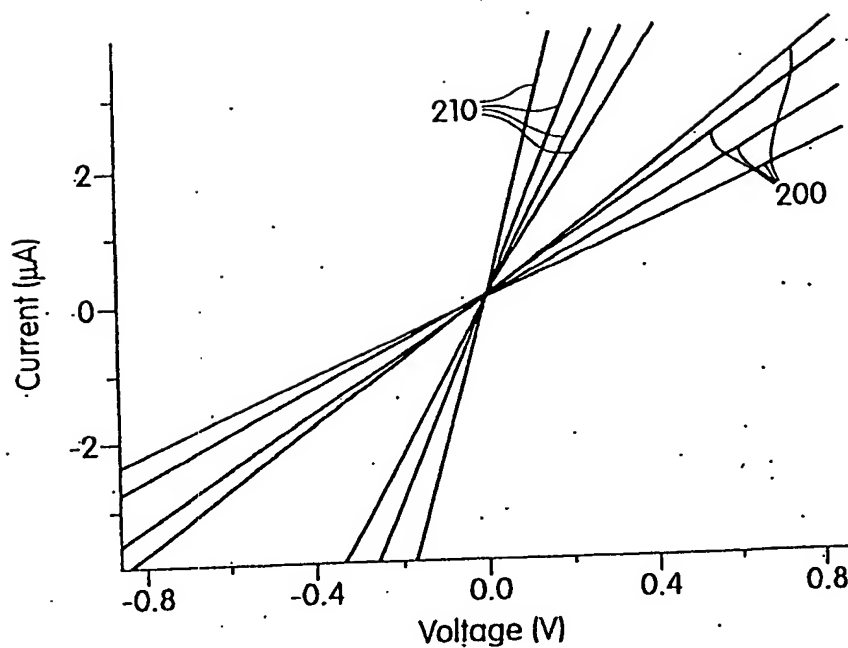


Fig. 33E

Fig. 34

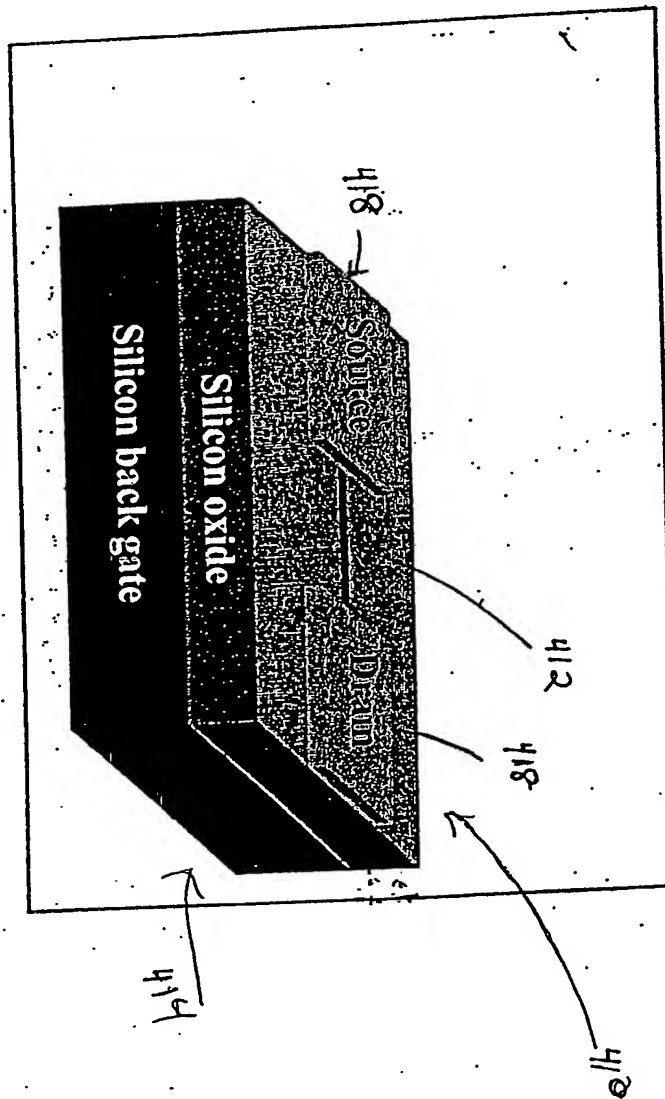


Fig 35A

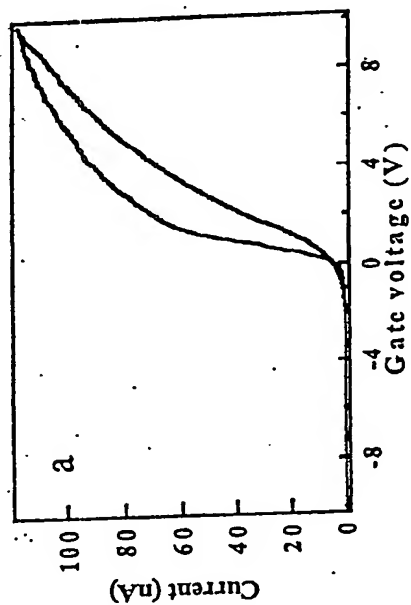


Fig 35B

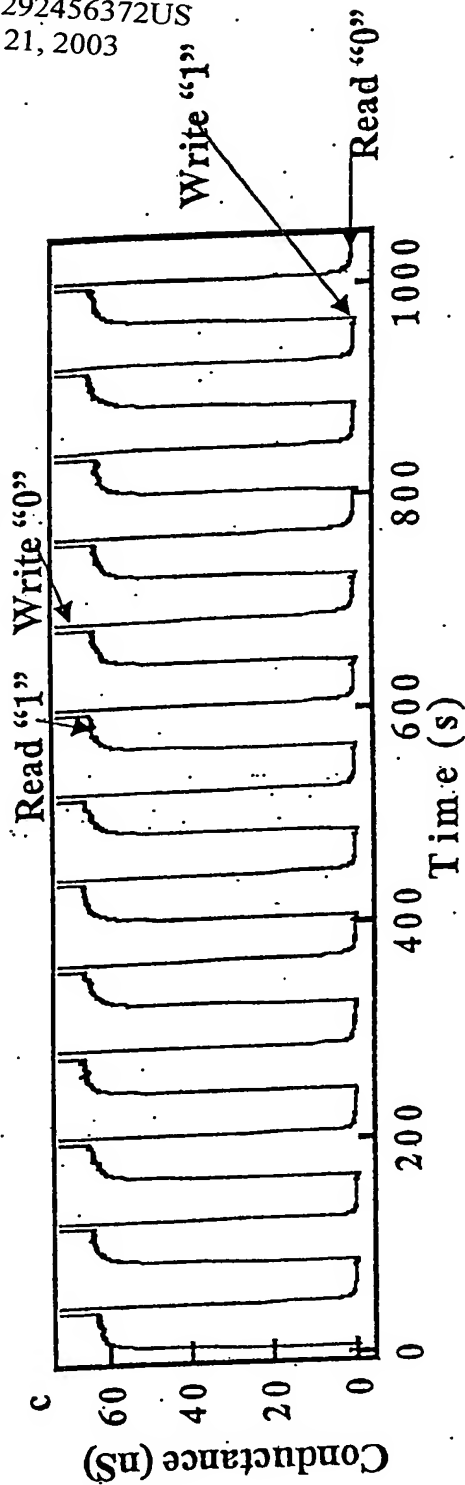
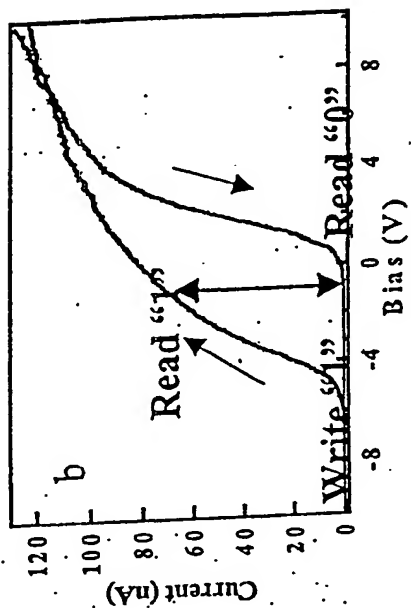


Fig. 35C

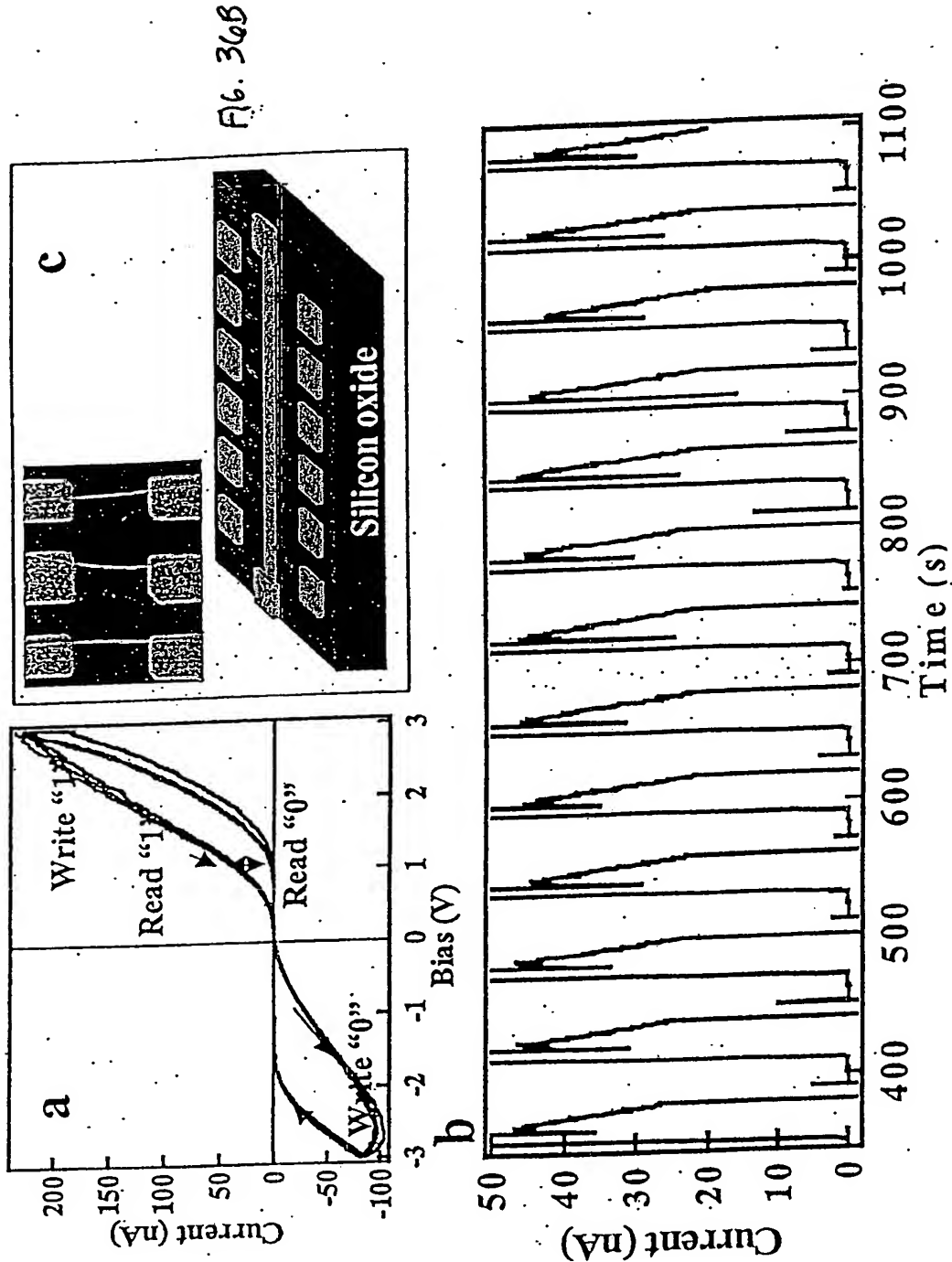
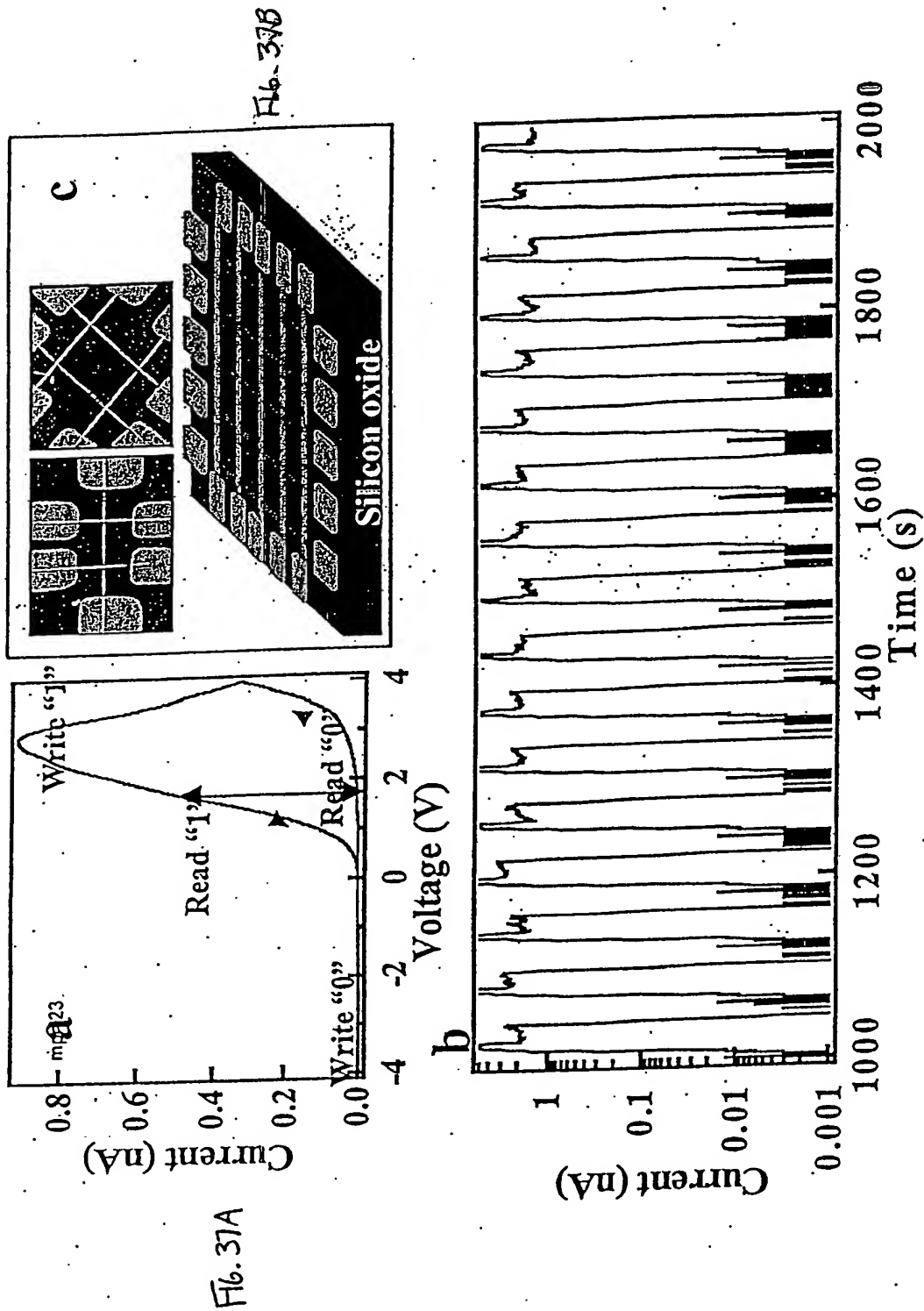


Fig. 36C



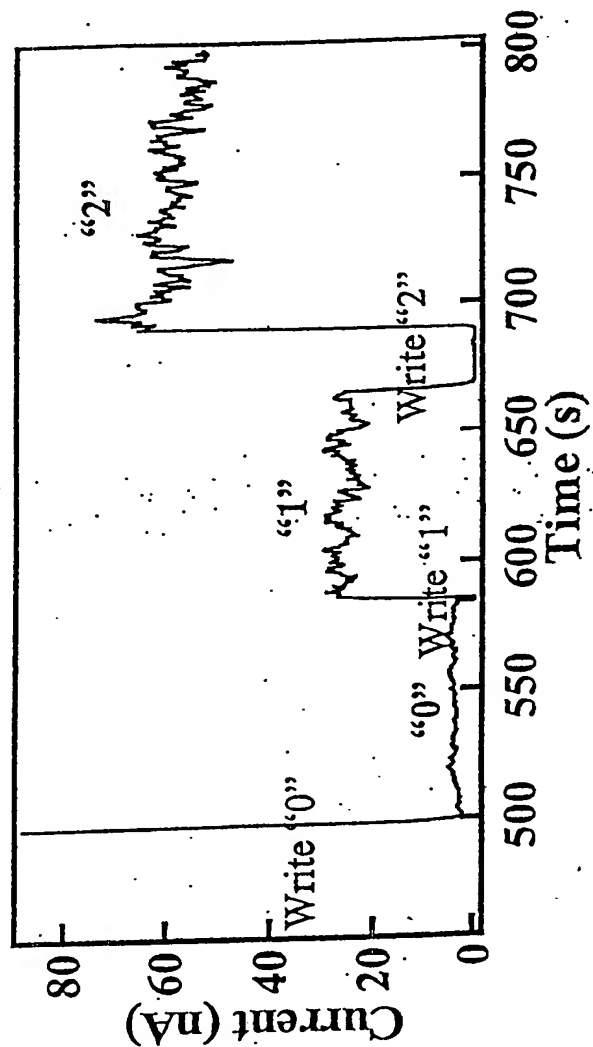


Fig. 38

Fig 39A

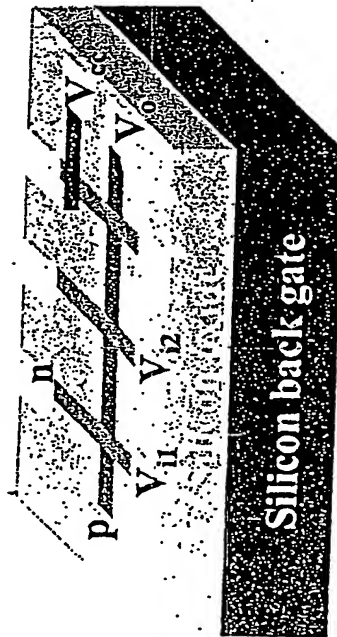


Fig 39B

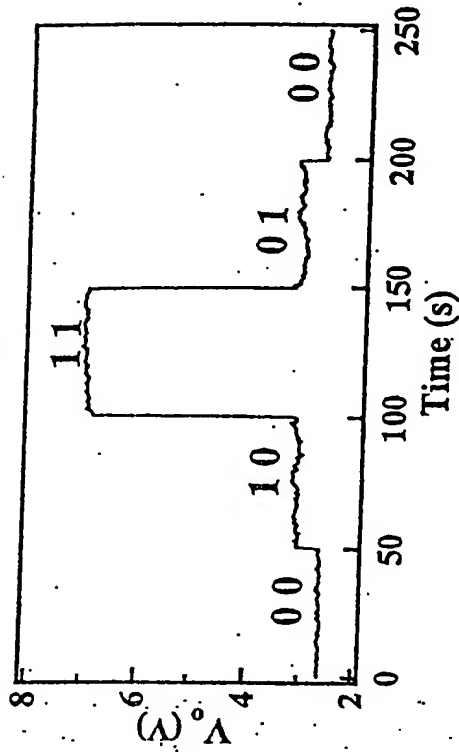


Fig 39C

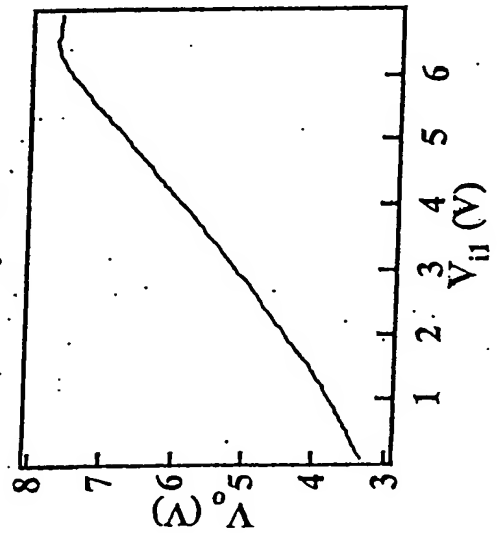


Fig 39D

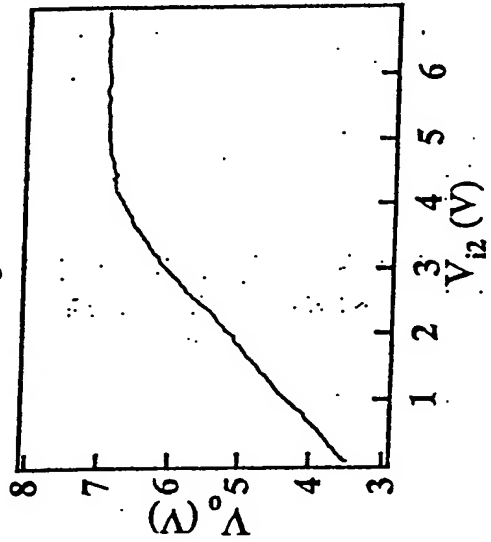


Fig 39E

V_{11}	V_{12}	V_o
0	0	0
0	1	0
1	0	0
1	1	1

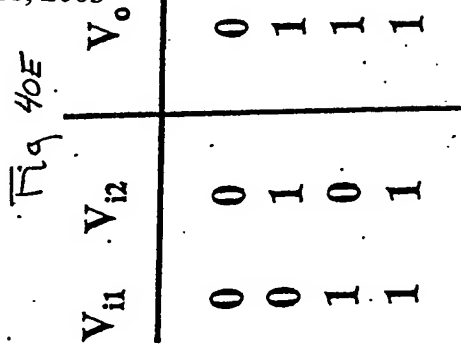
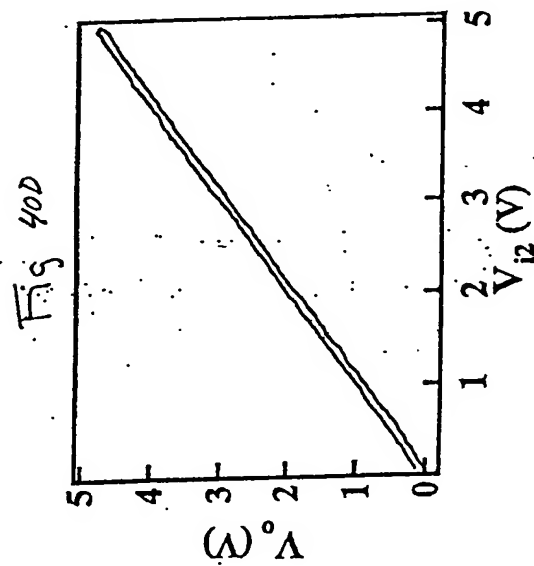
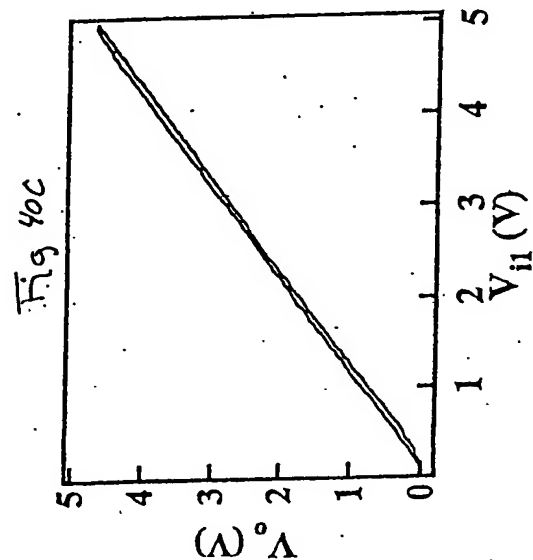
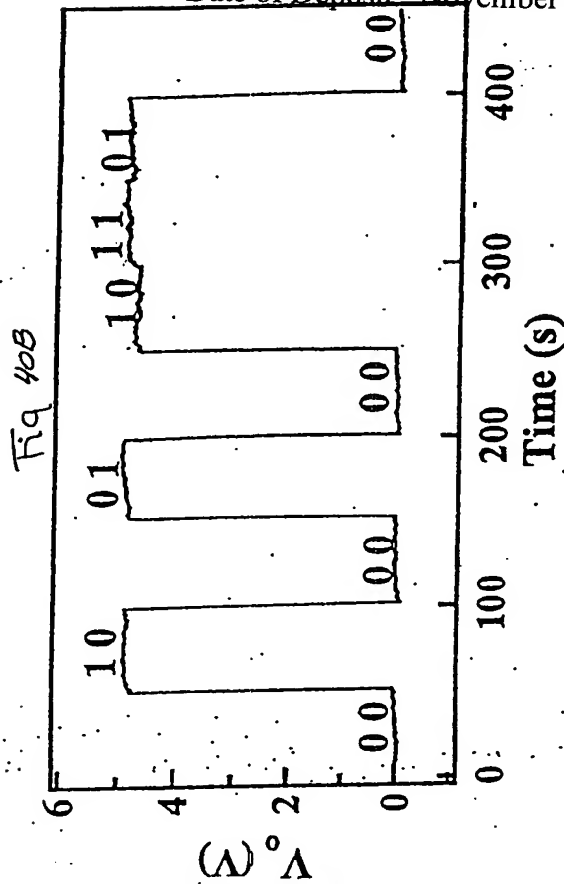
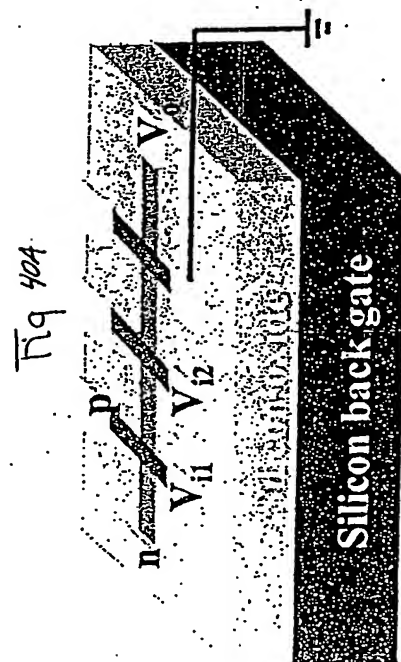
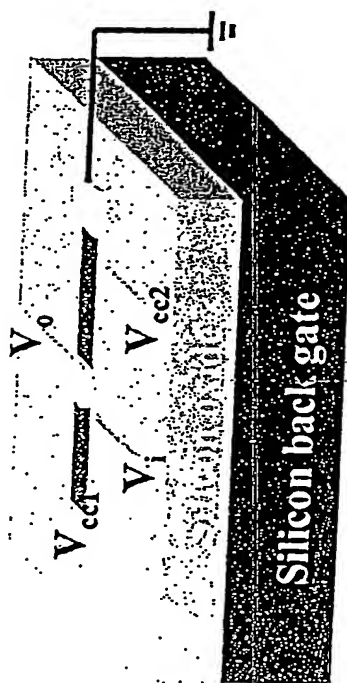


Fig 4/A



$V_{cc1} = 5\text{ V}$, $V_{cc2} = 2\text{ V}$, $V_i = 0, 5\text{ V}$

Fig 4/B

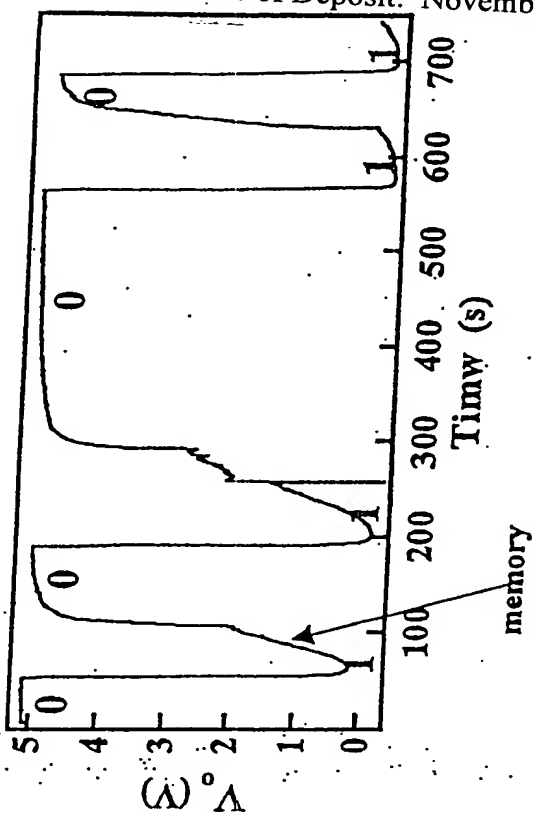


Fig 4/C

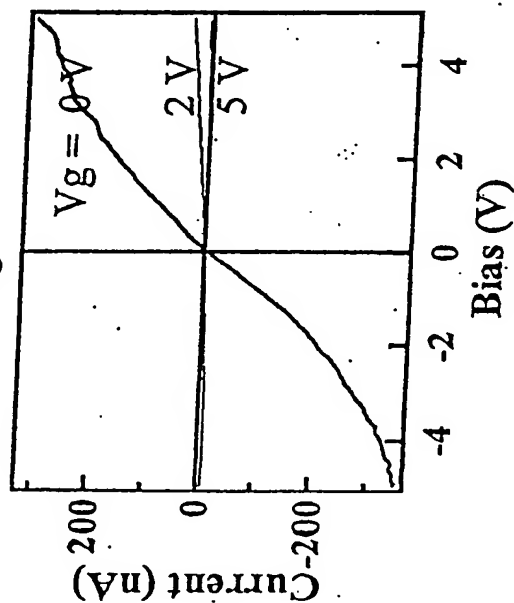


Fig 4/D

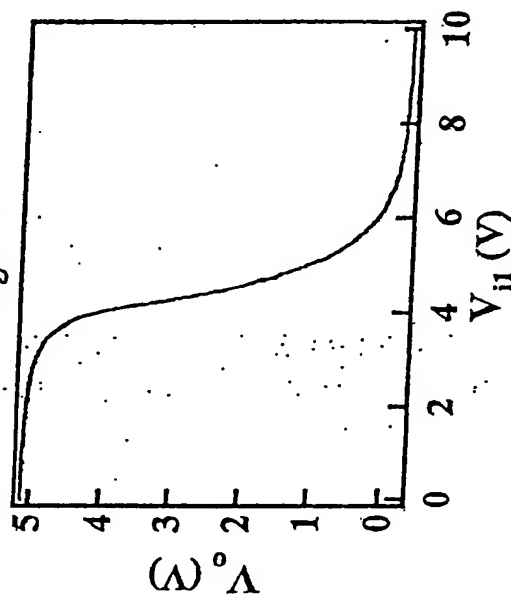


Fig 4/E

V_i	V_o
0	0
1	0

Fig 42B

V_{i1}	V_{i2}	V_o
0	0	1
0	1	0
1	0	0
1	1	0

Fig 42A

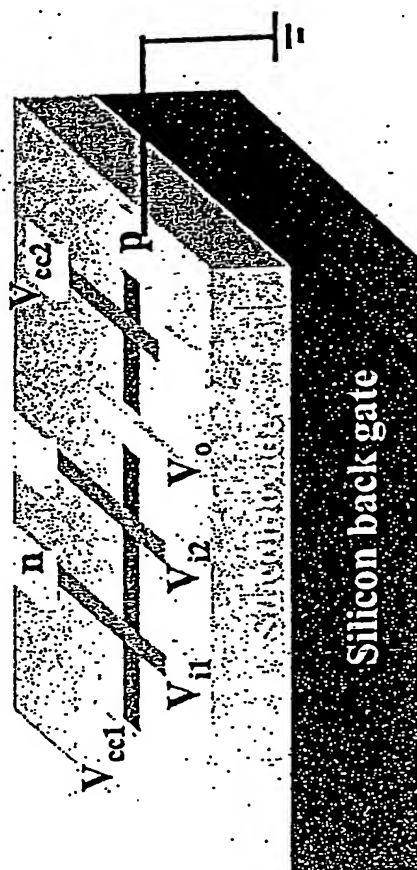


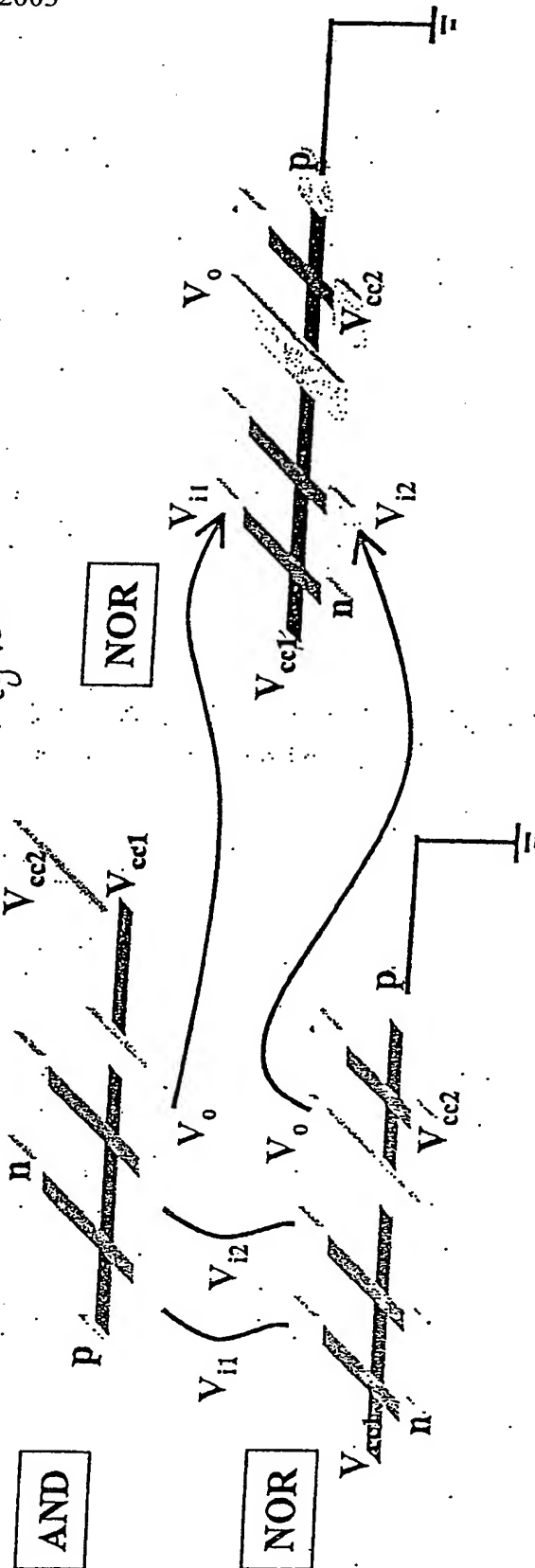
Fig. 43A

V_{i1}	V_{i2}	NOR AND V_o	V_o
0	0	1	0
0	1	0	1
1	0	0	1
1	1	0	0

INPUT TO NOR



Fig 43B



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Fig. 44A

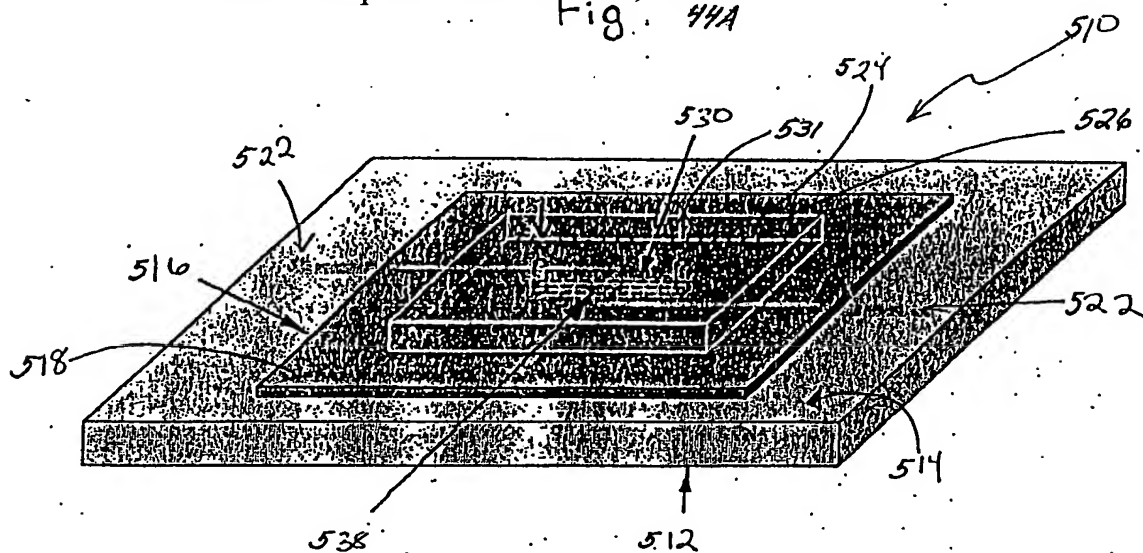
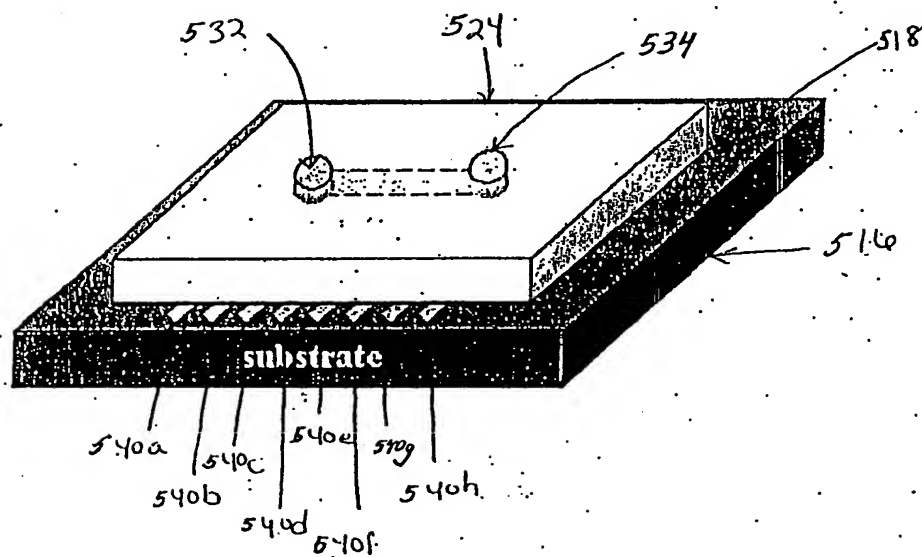


Fig. 44B



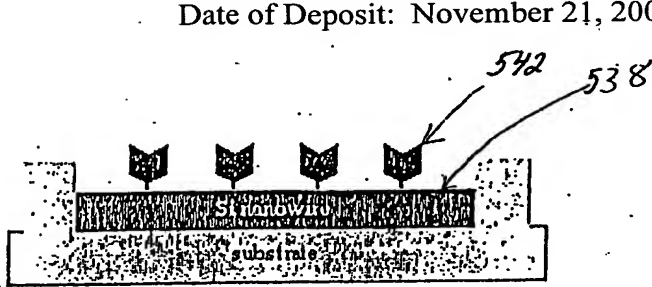


Figure 45A

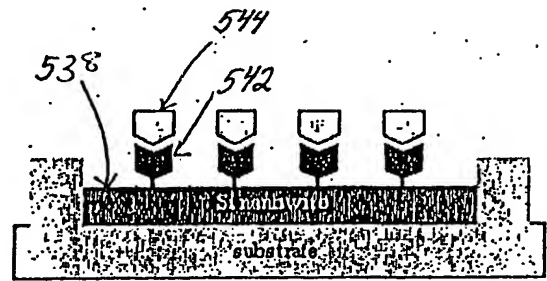


Figure 45B

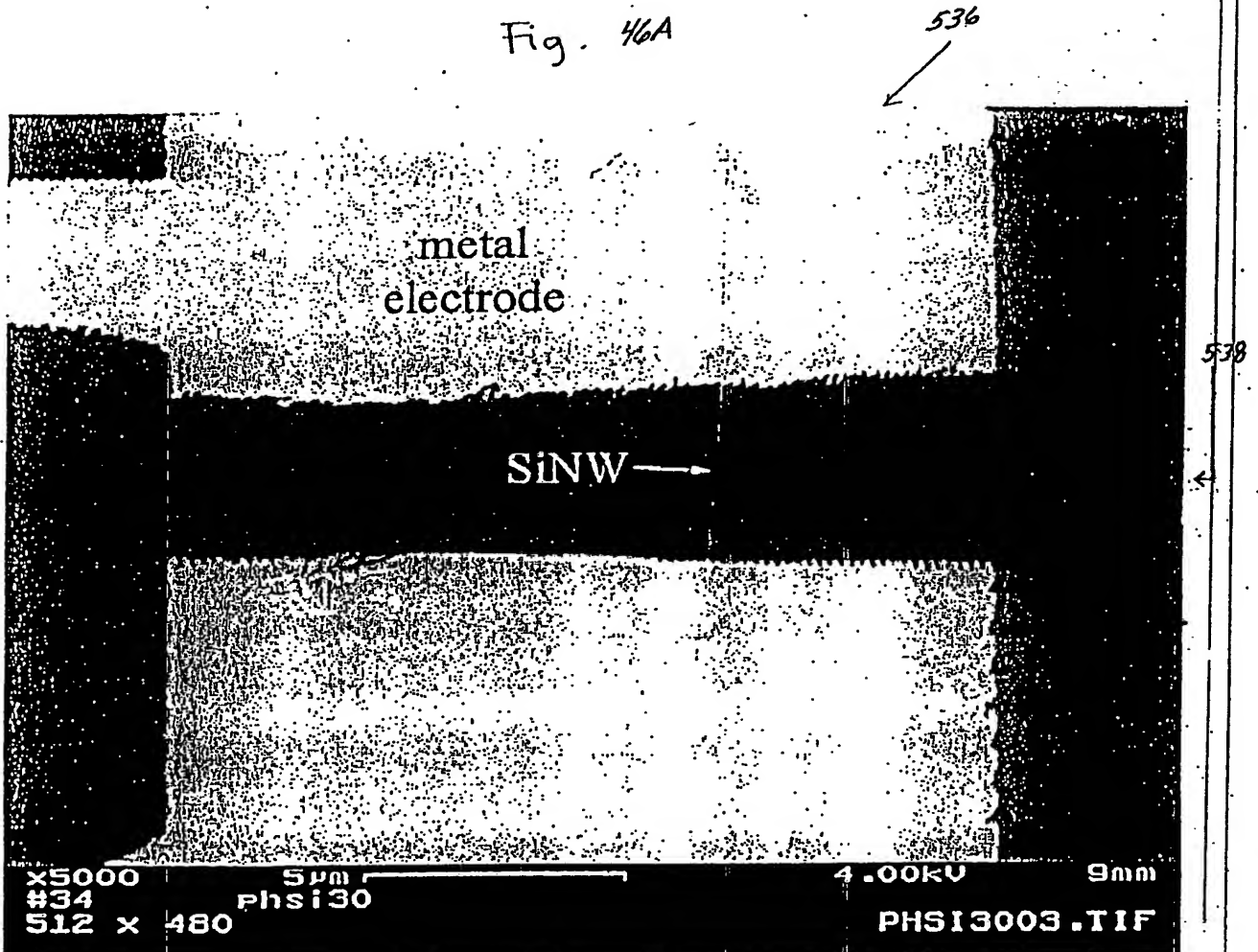
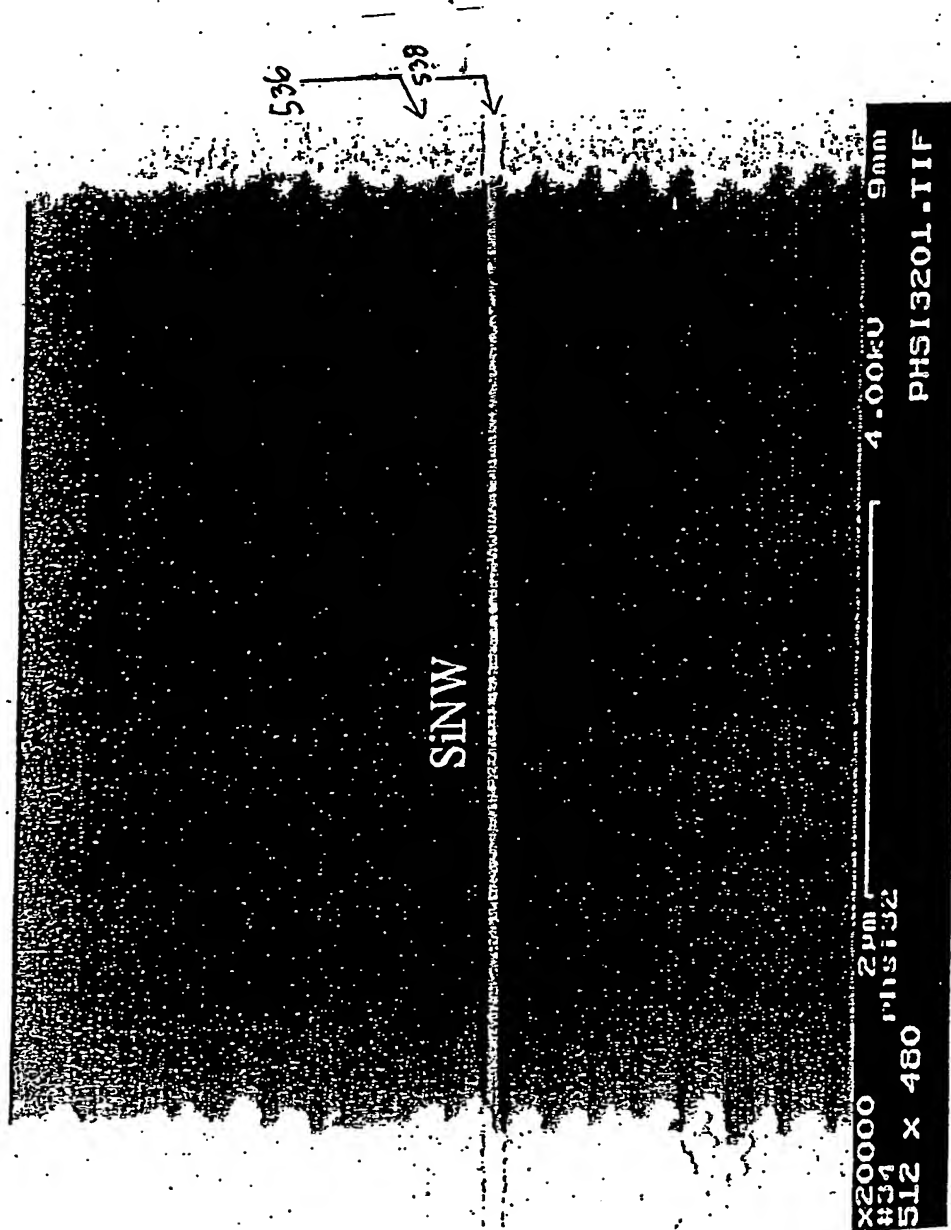


Fig. 46A

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Fig. 46B



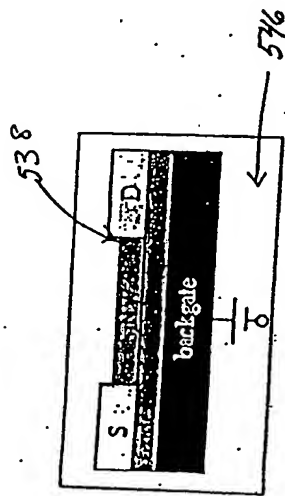
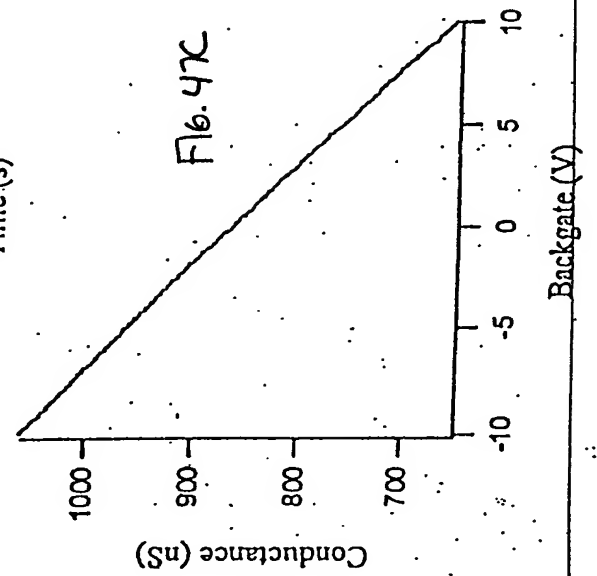
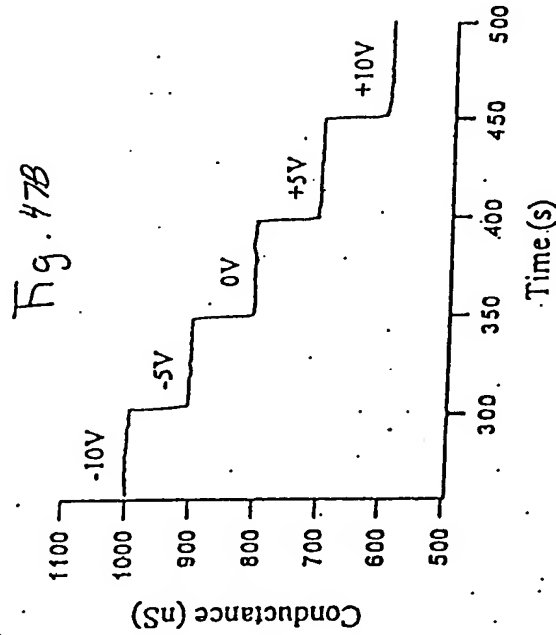
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FIG. 48A

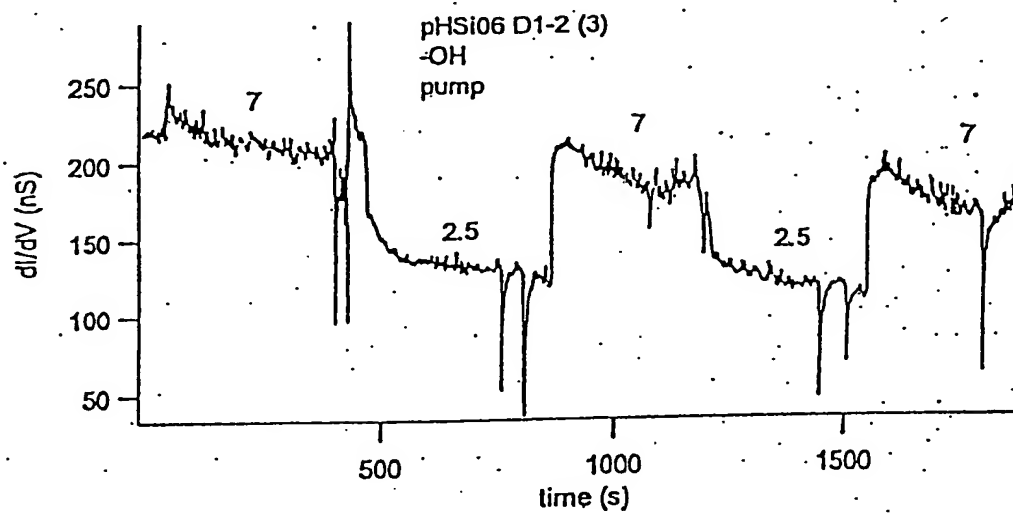


FIG. 48B

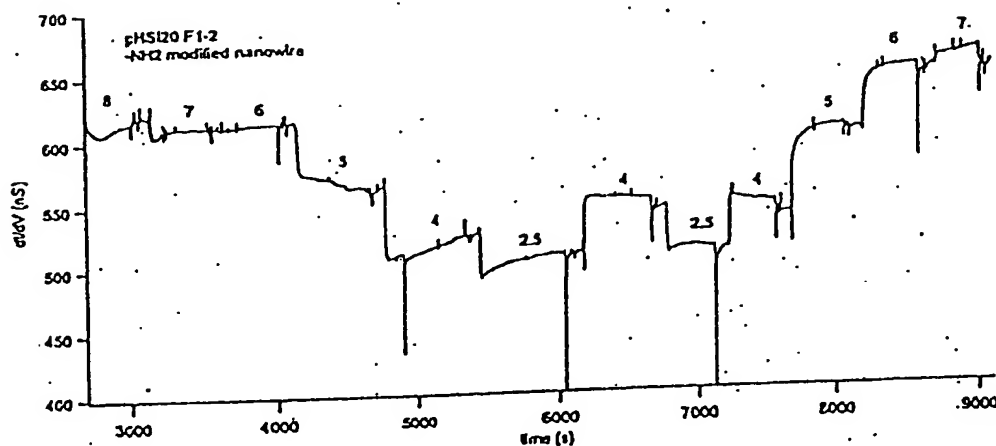


FIG. 49

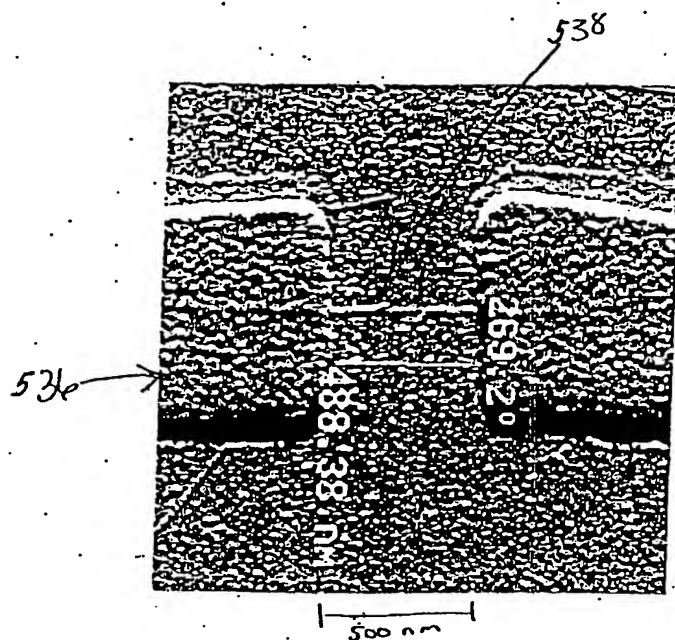
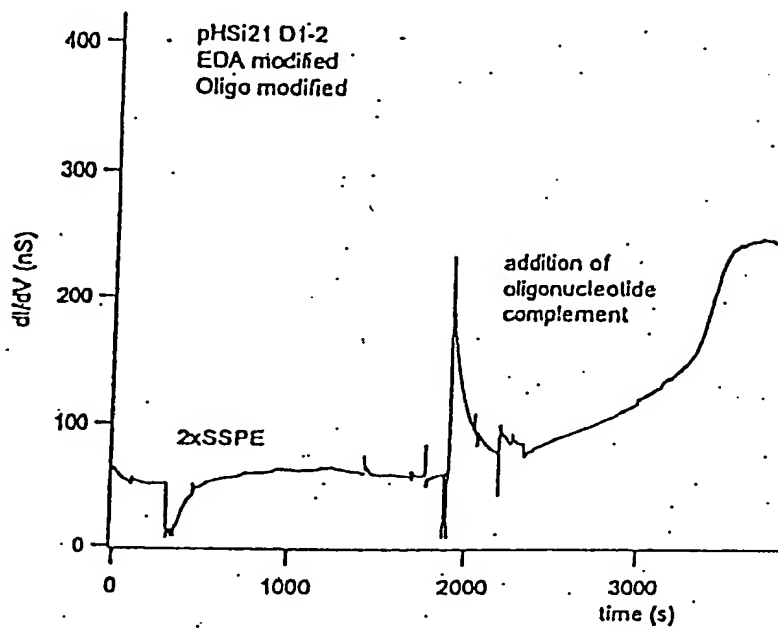


Fig. 50

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FIG. 51A

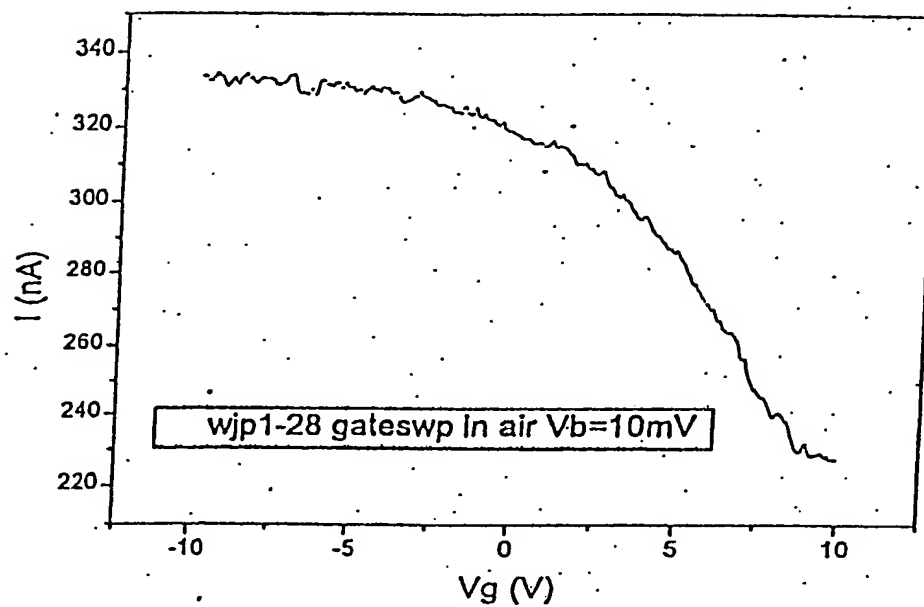


FIG. 5/B

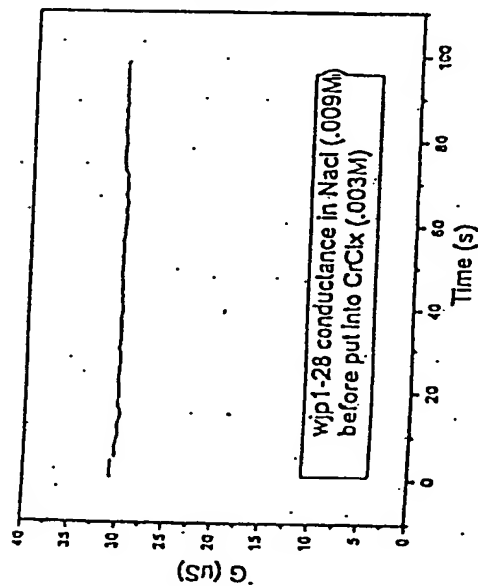
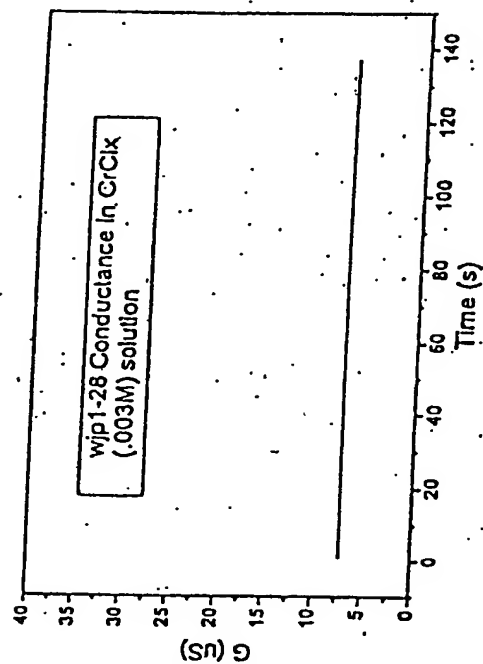


FIG. 5/C



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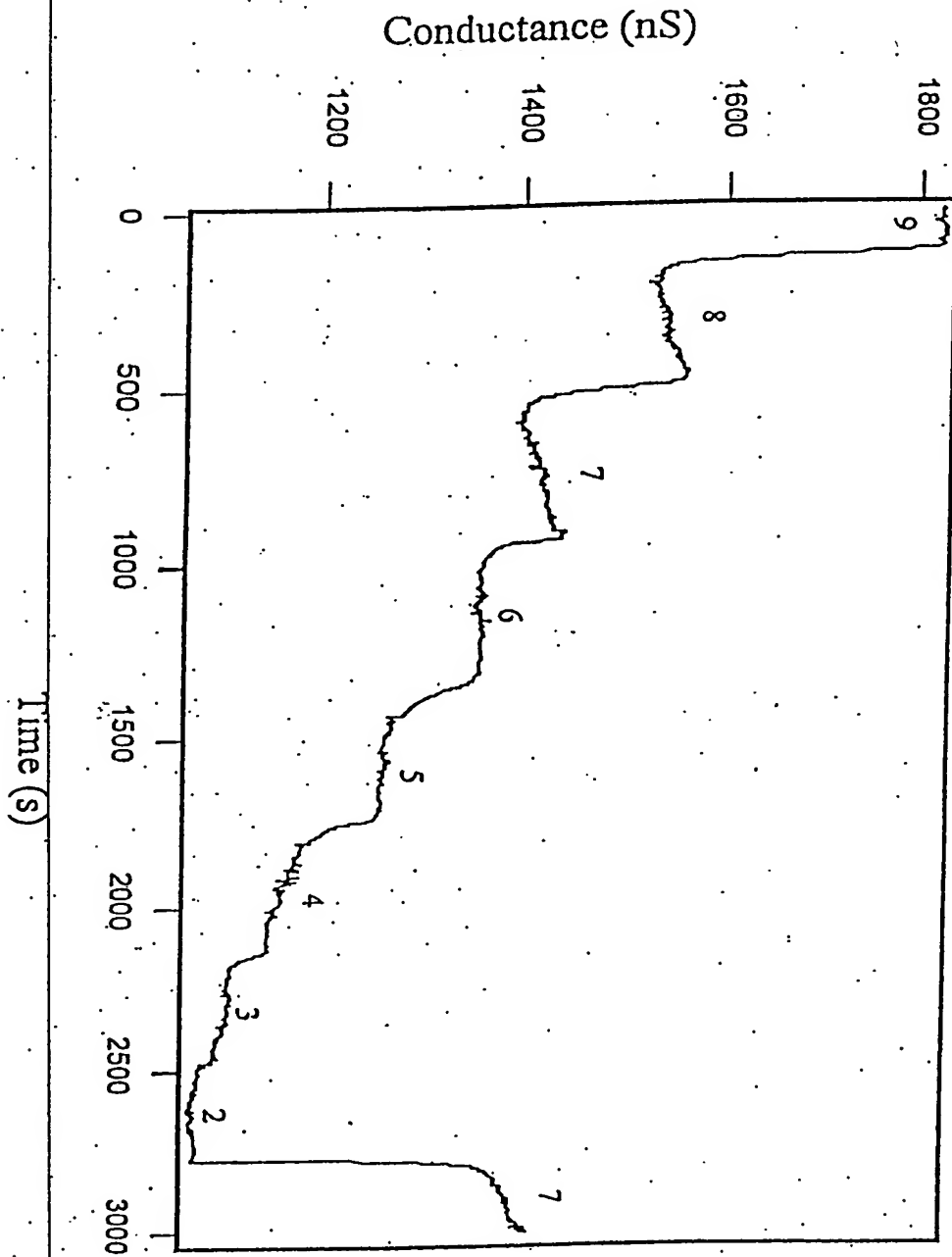


Fig 52A

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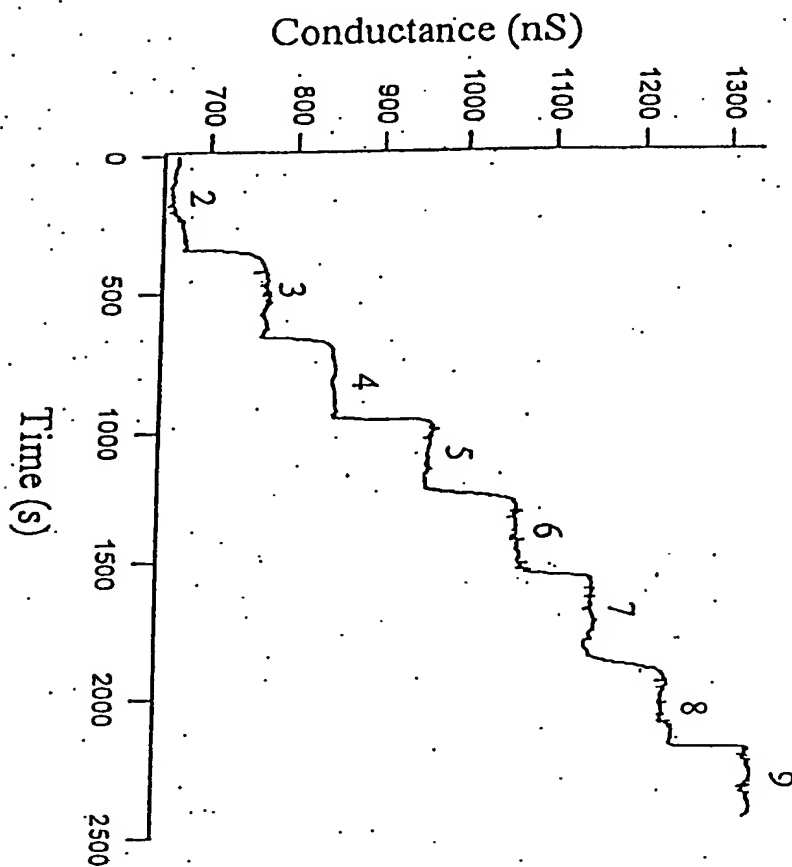


Fig 5aB

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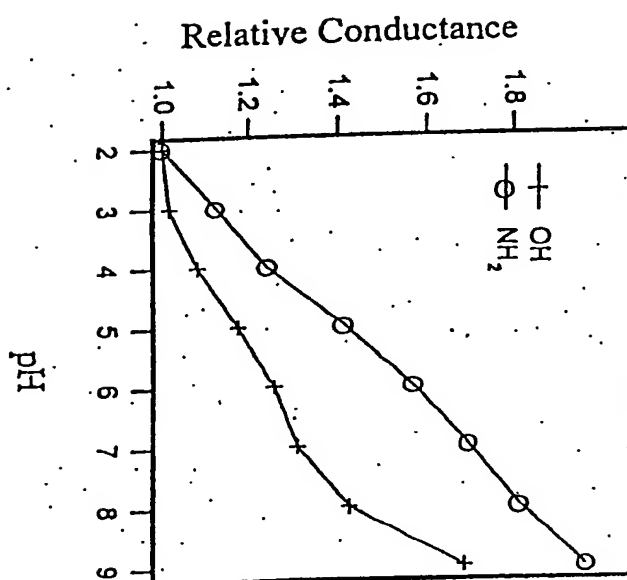


Fig. 5a

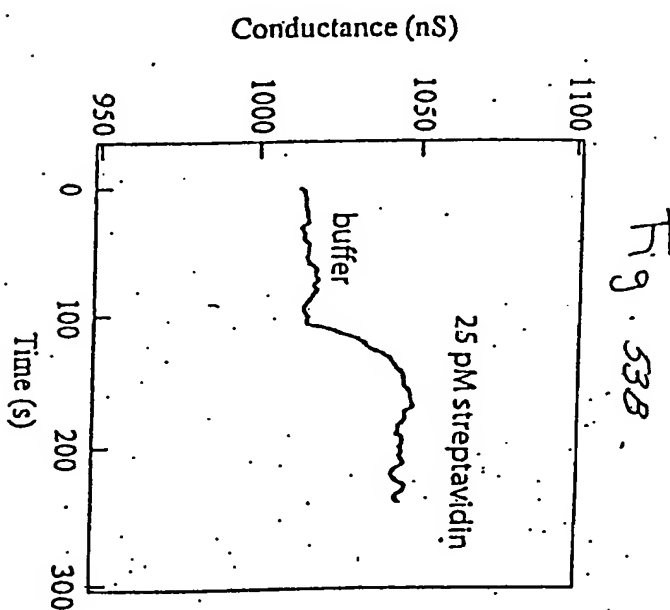
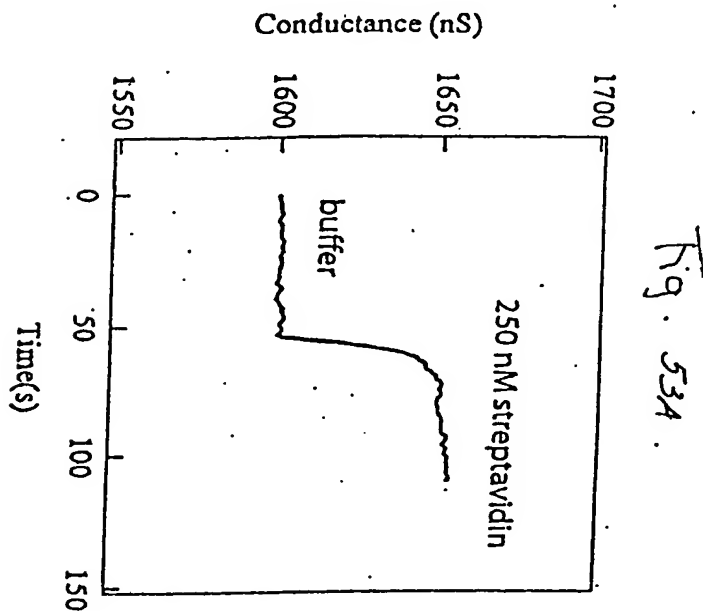
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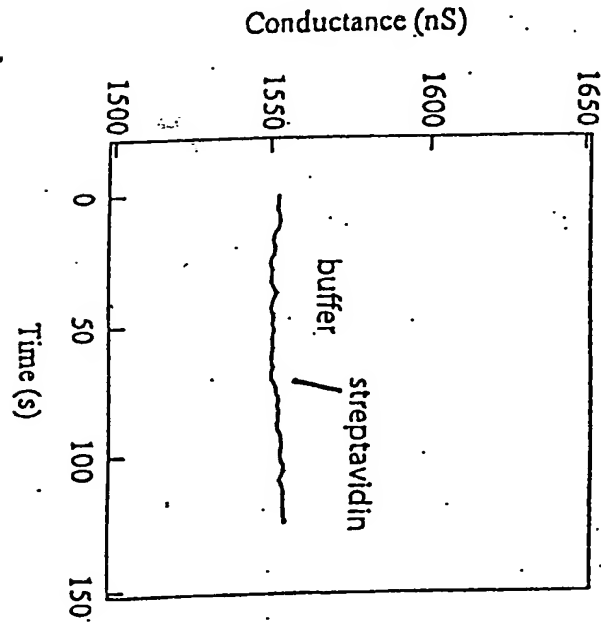


Fig. 53c

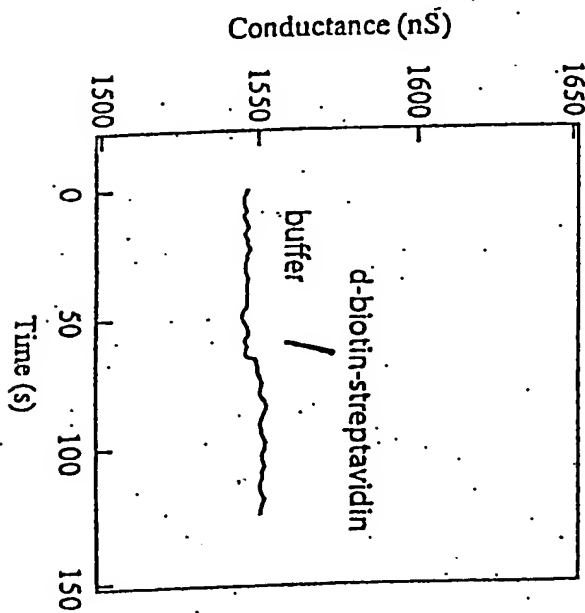


Fig. 53d

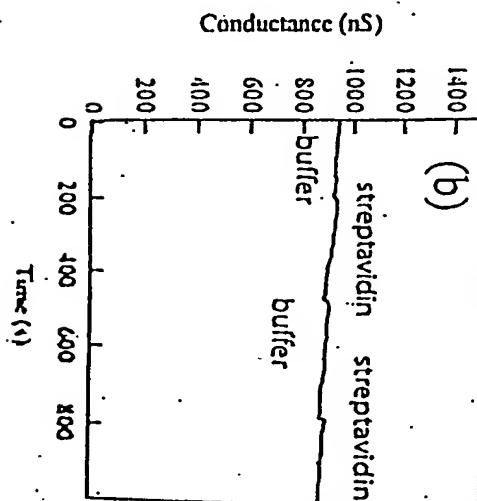
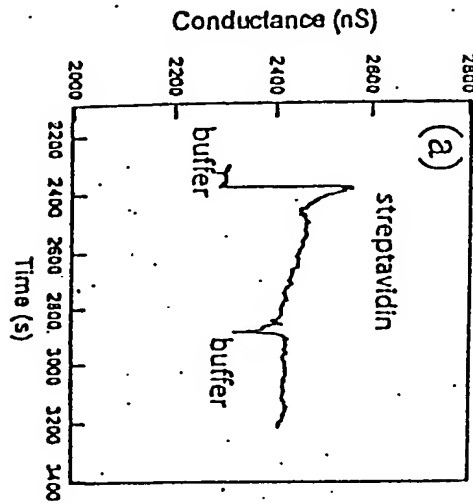
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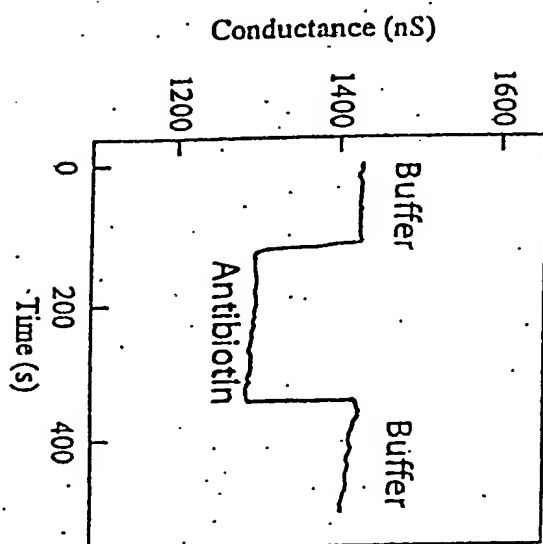


Fig. 54A

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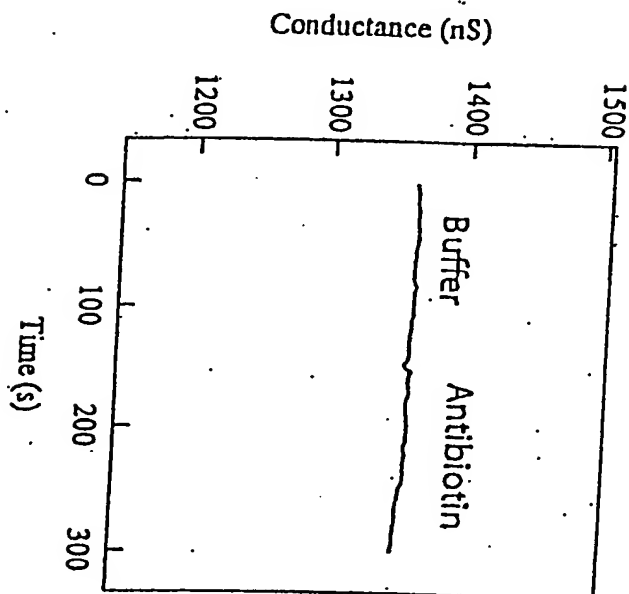


Fig. 54b

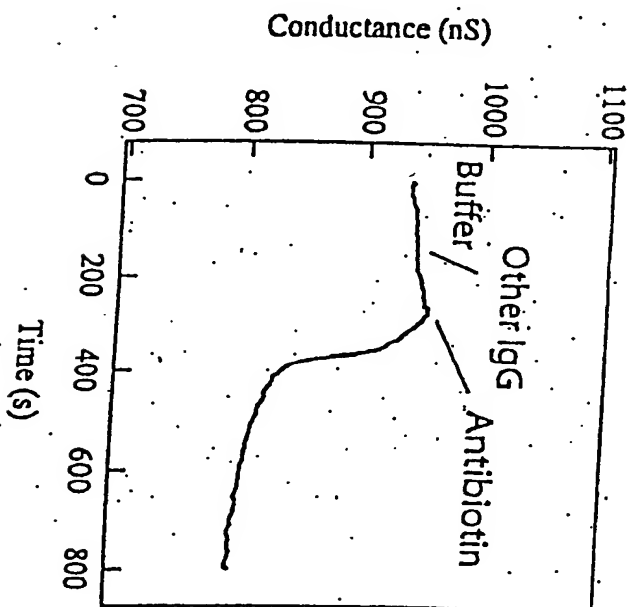


Fig. 54c

Fig 55A

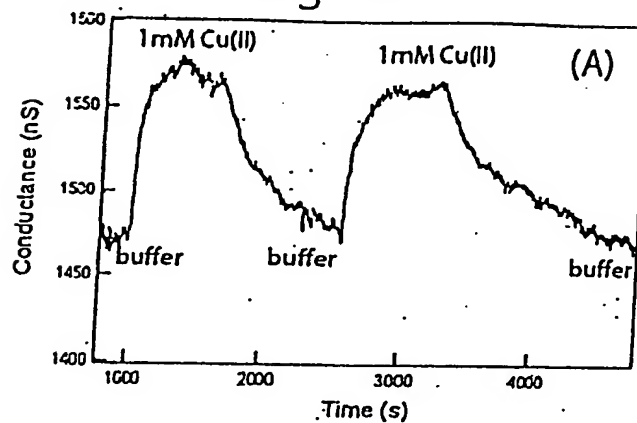


Fig. 55B

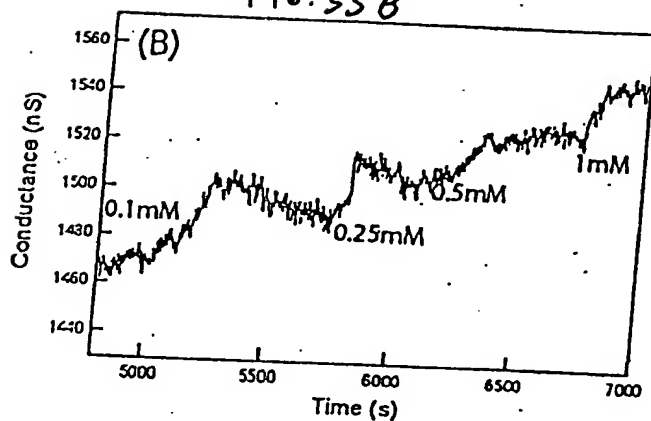


Fig 55C

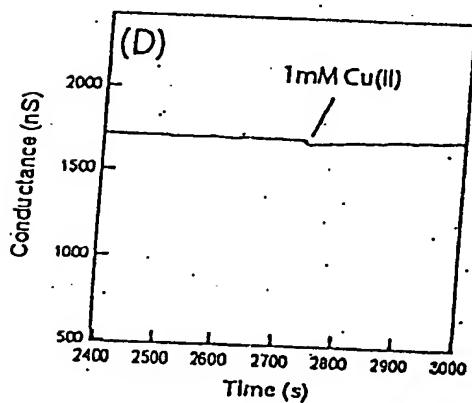
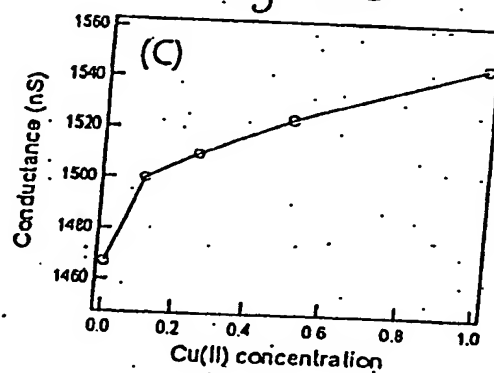


Fig. 55D

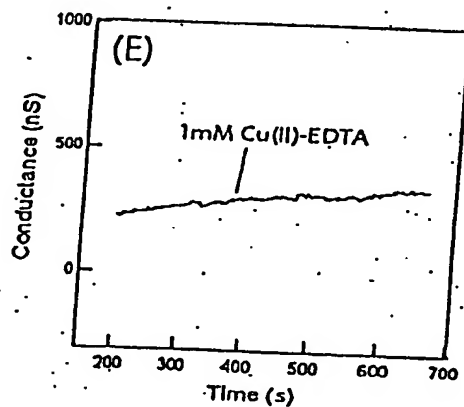


Fig. 55E

FIG. 56A

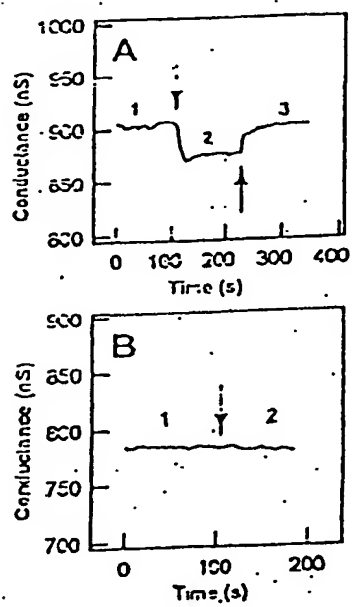


Fig 56B

Sensitivity dependent on
 doping and size of nanowires

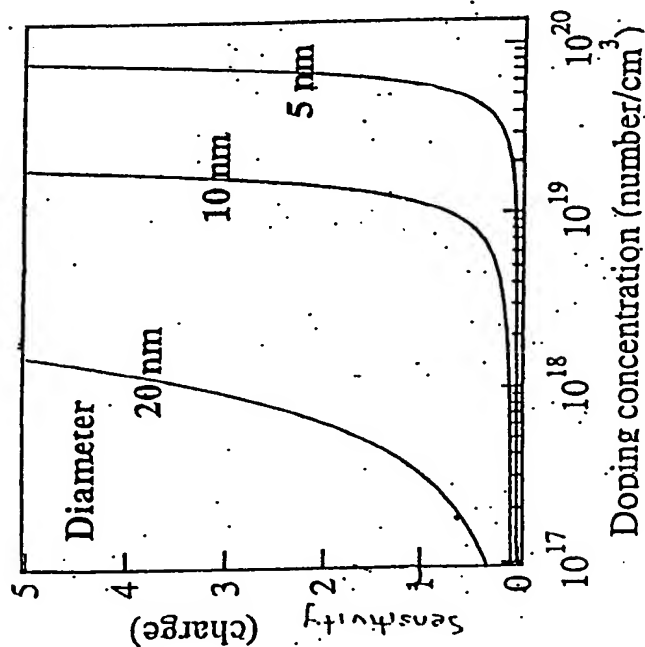


Fig 574

Threshold doping density
 for single charge detection

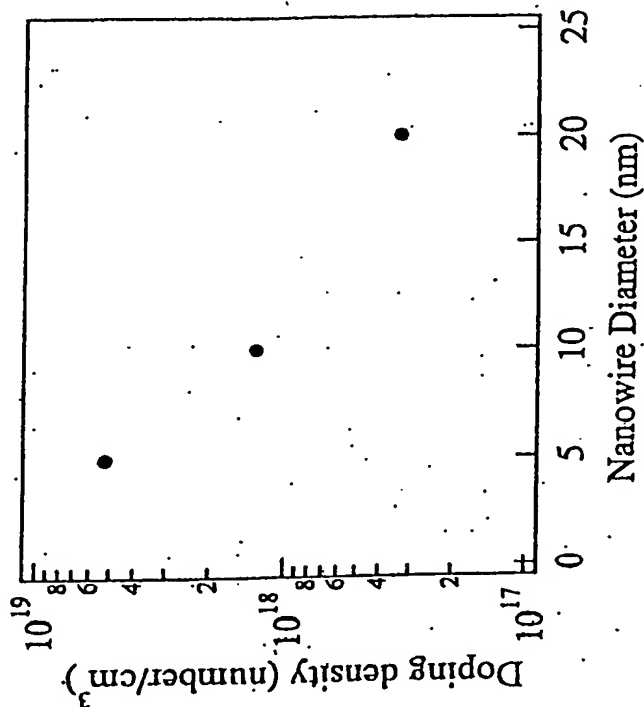


Fig 578

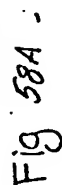


Fig. 59a

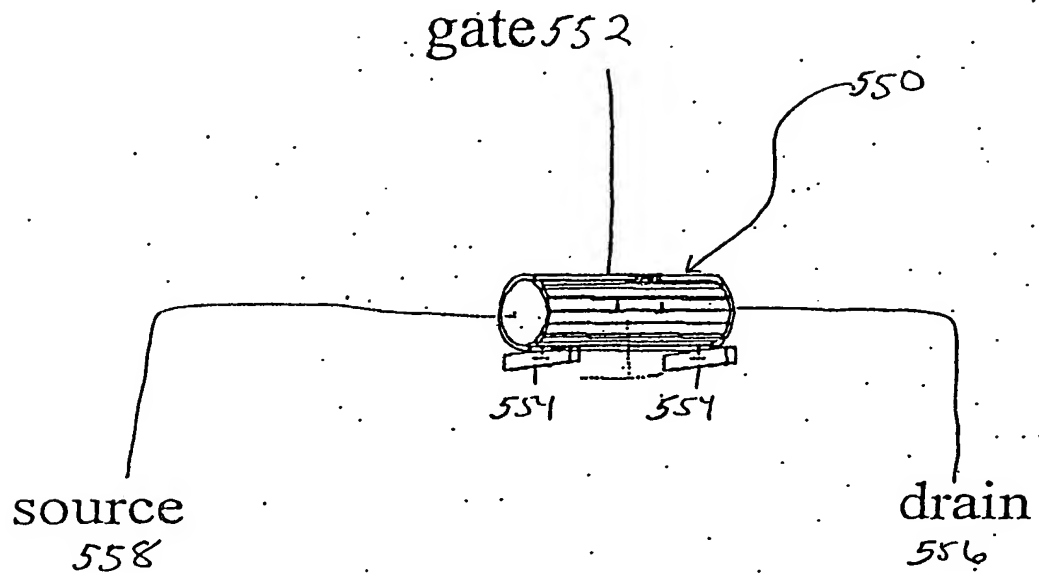


Fig. 59 b

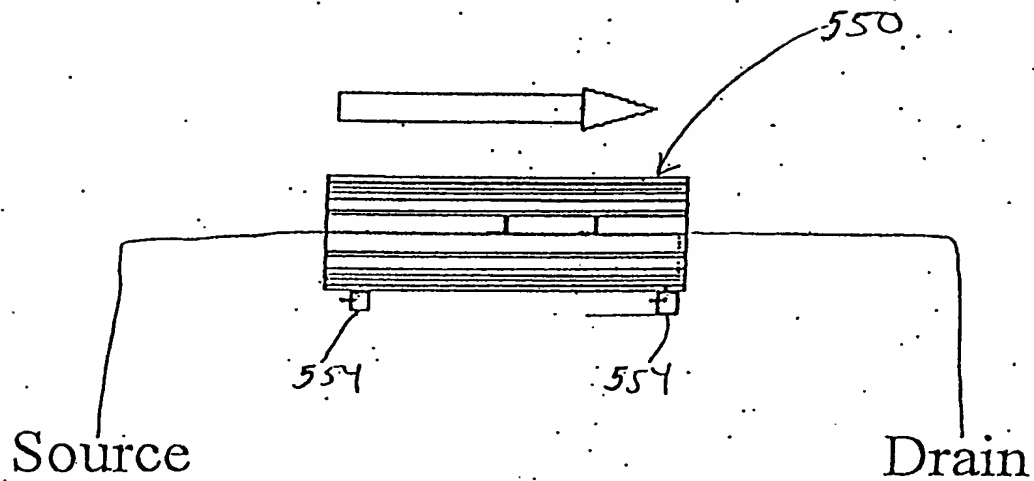


Fig. 59 c

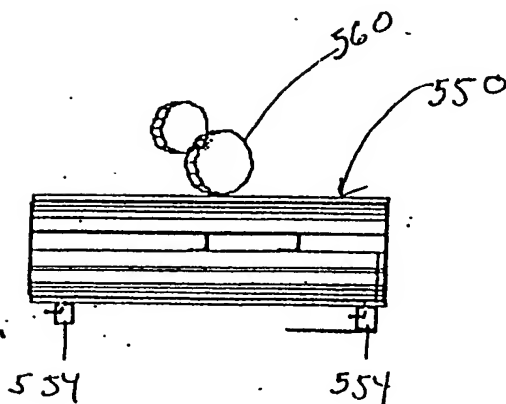
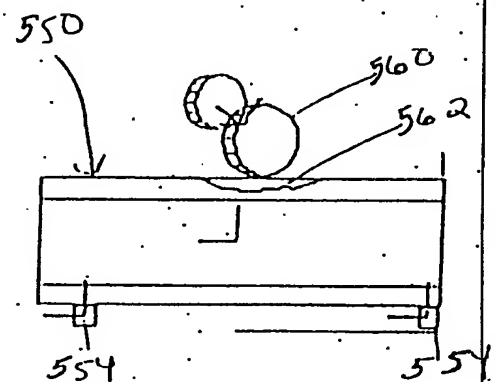


Fig. 59 d



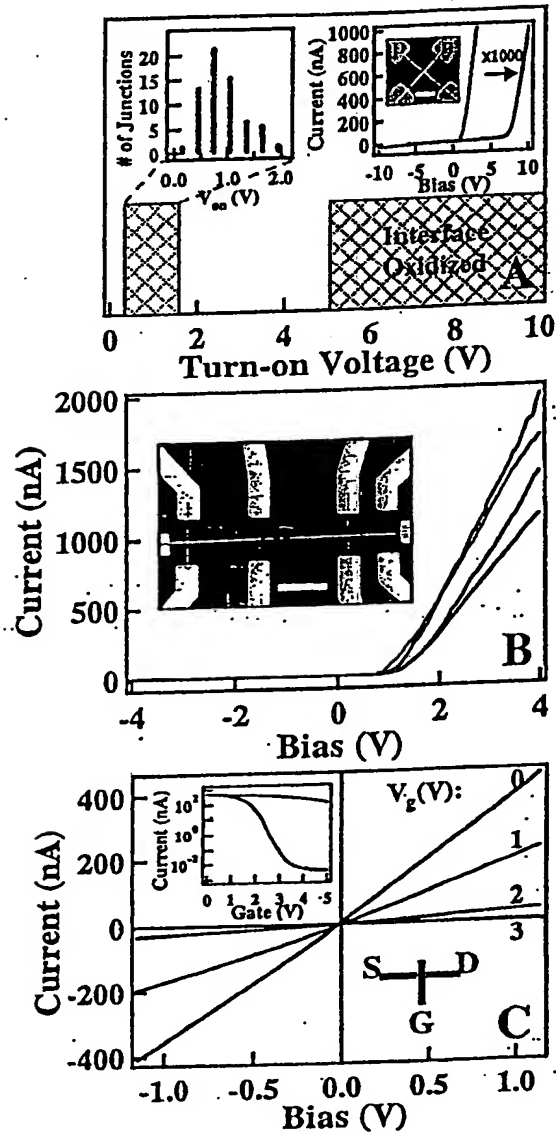


Figure 60

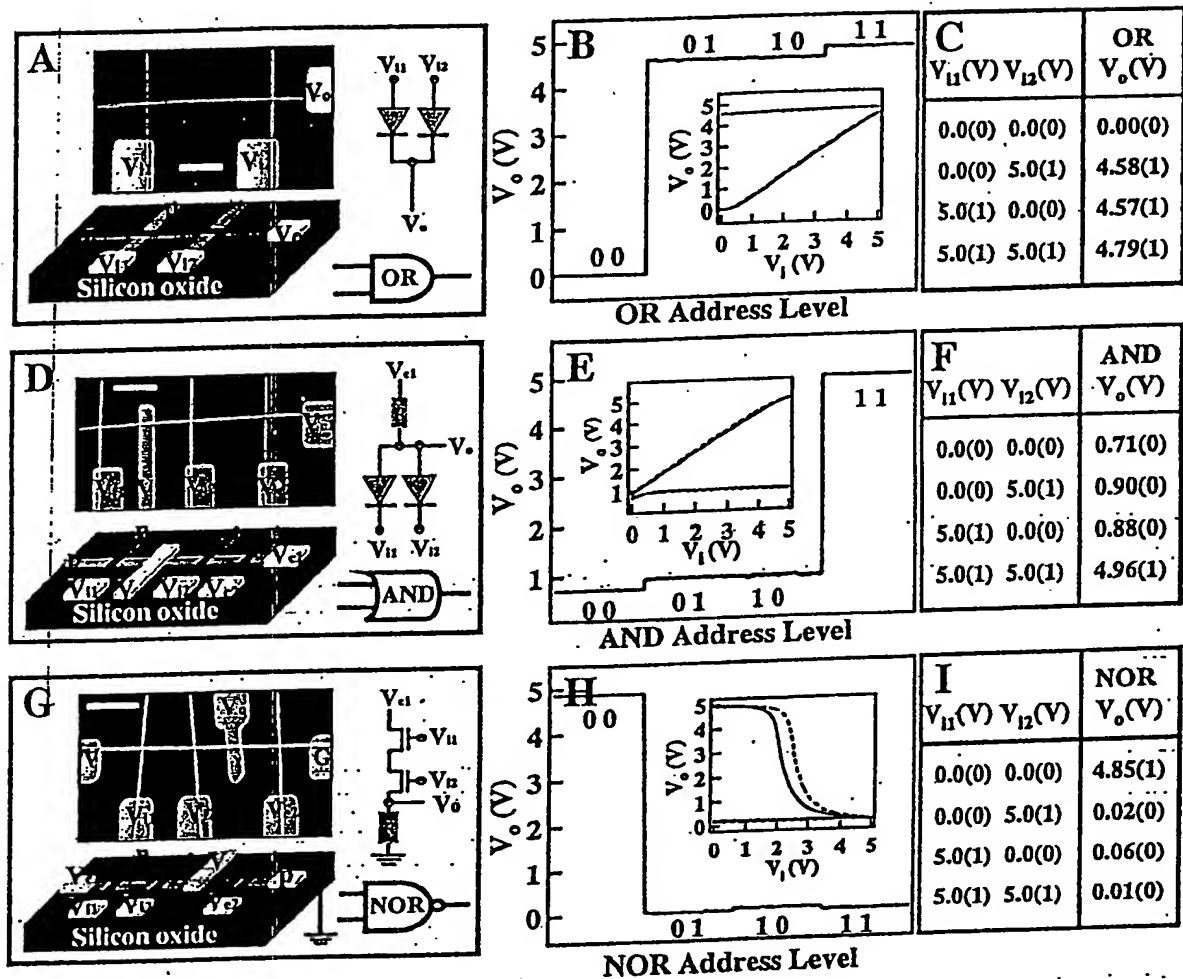


Figure 61

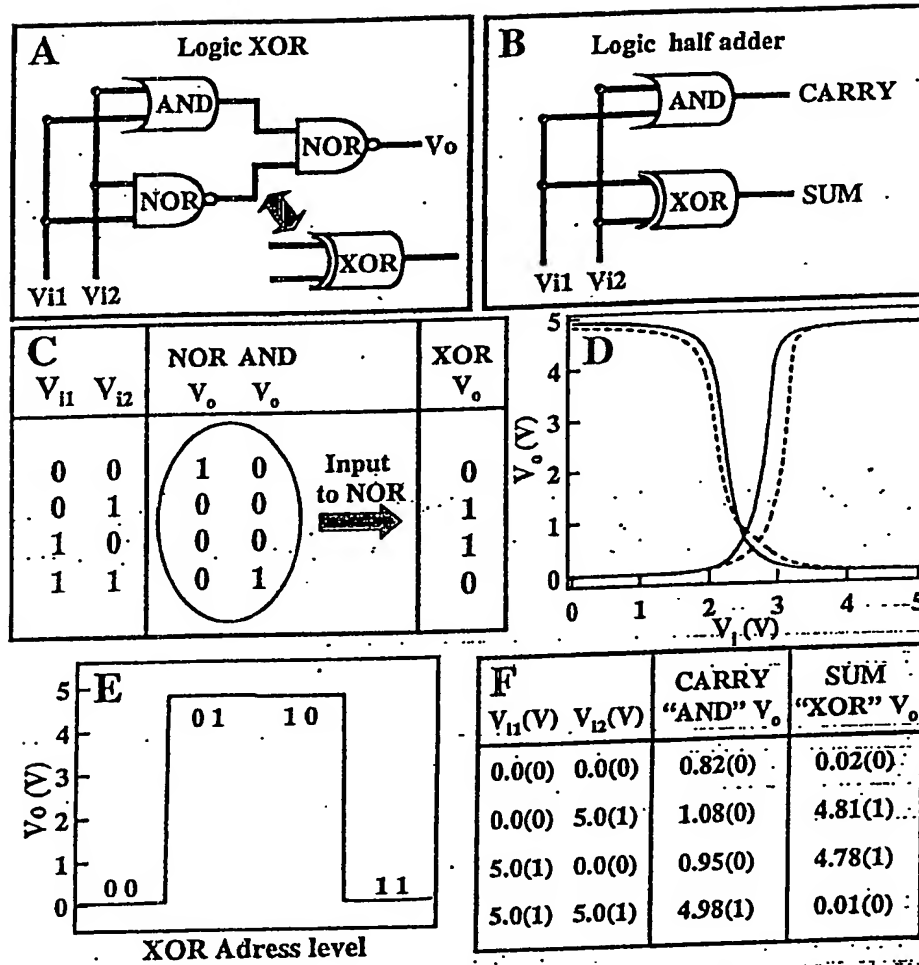


Figure 62

Fig. 63A

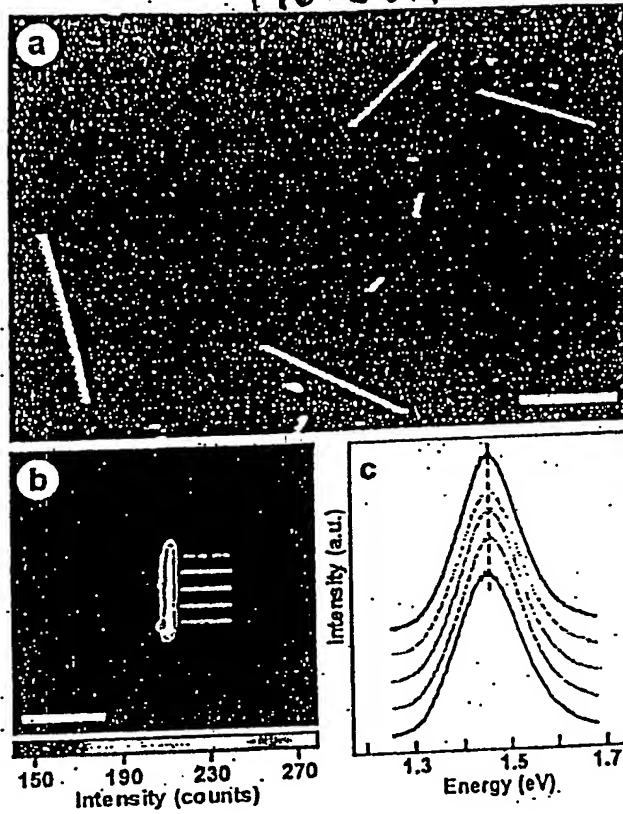


Fig 63B

Fig 63C

Fig 64A

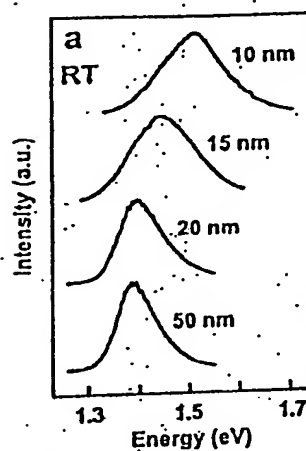


Fig 64B

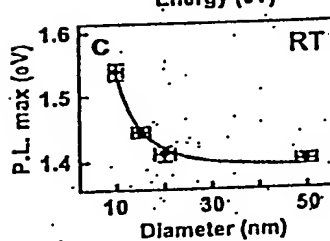
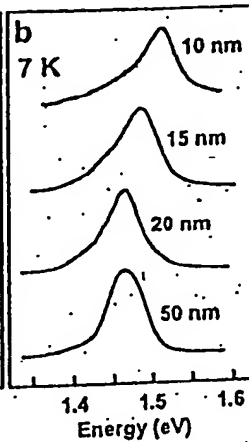


Fig 64C

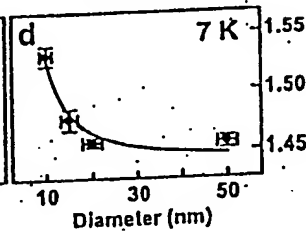


Fig 64D

Fig 65A

Fig 65B

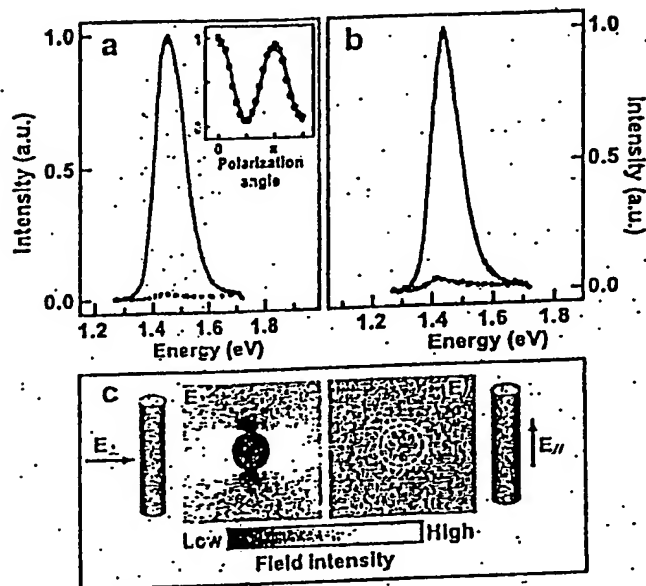


Fig 65C

Fig. 66A

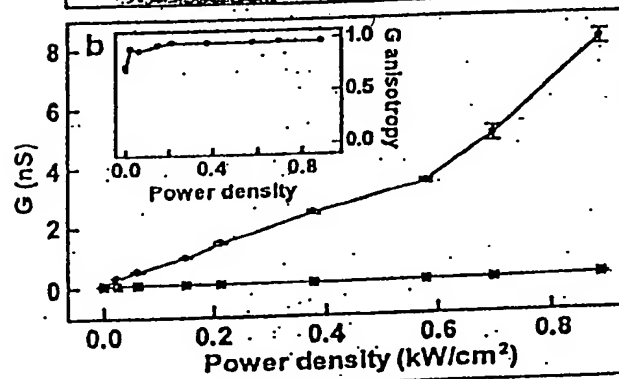
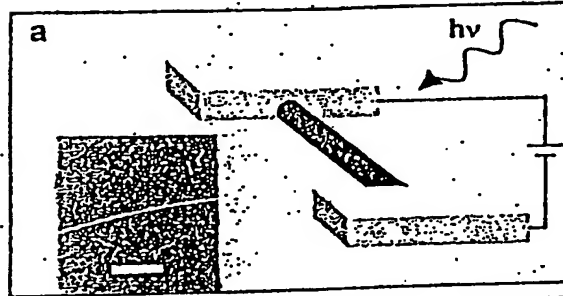


Fig. 66B

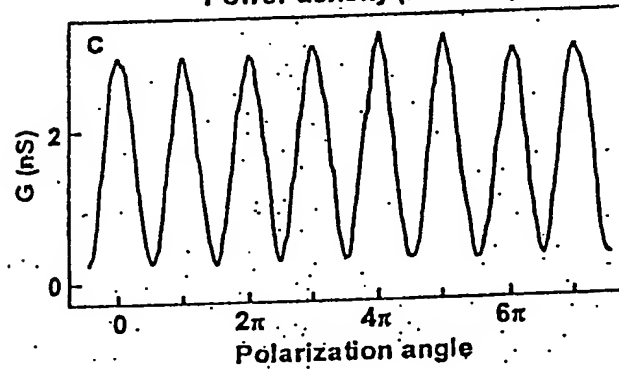


Fig. 66C

FIG. 67

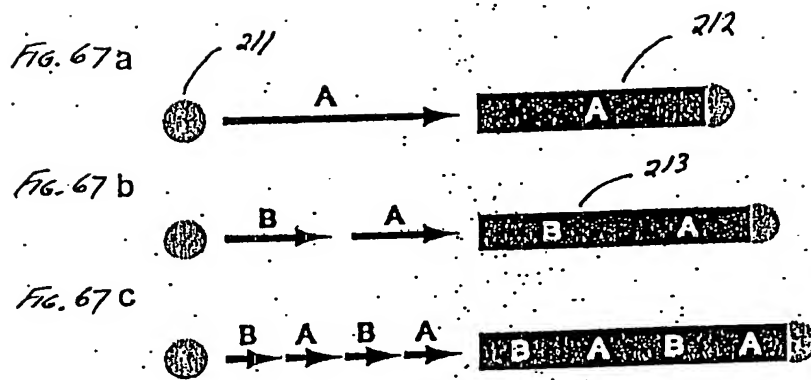


FIG. 68

Fig. 68a

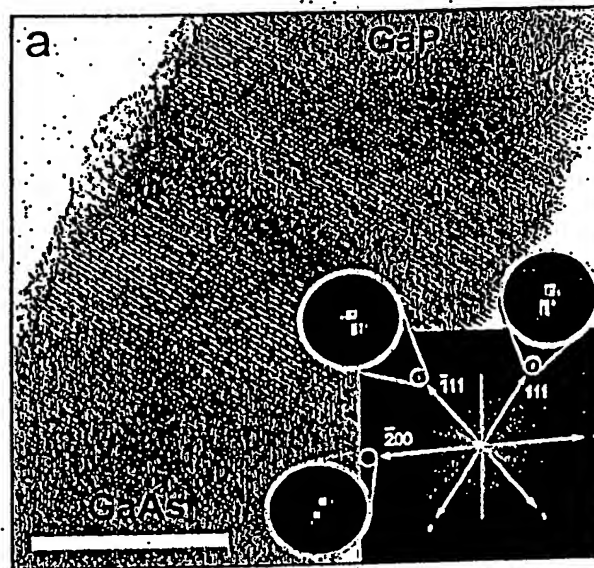


Fig 68b

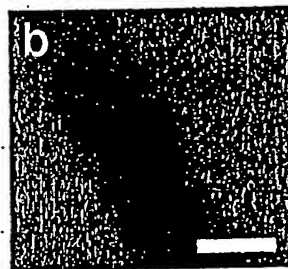


Fig 68c

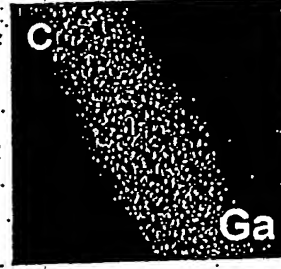


Fig 68d

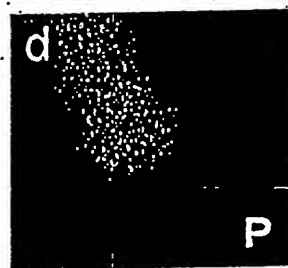


Fig. 68E



Fig. 68F

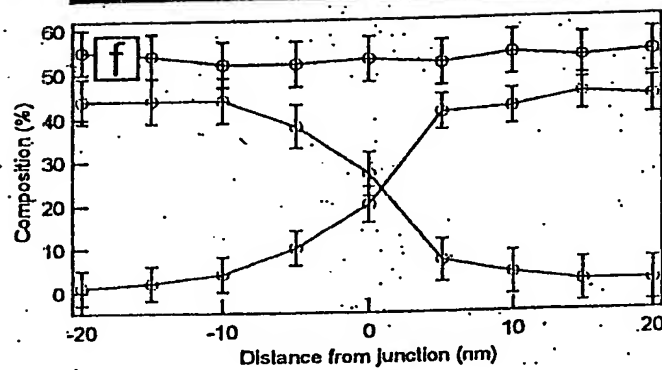


Fig. 69

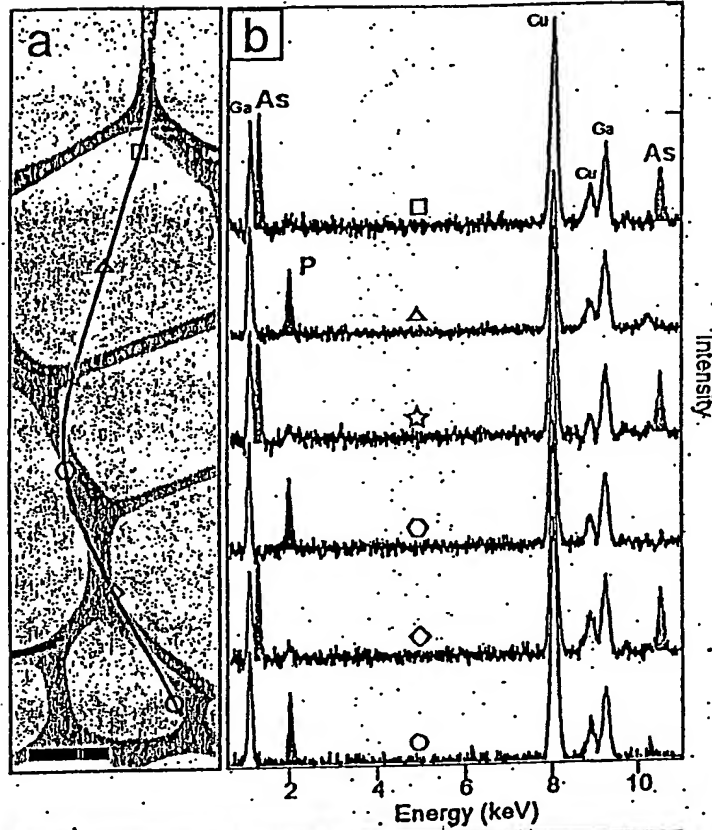


Fig. 69A

Fig. 69B

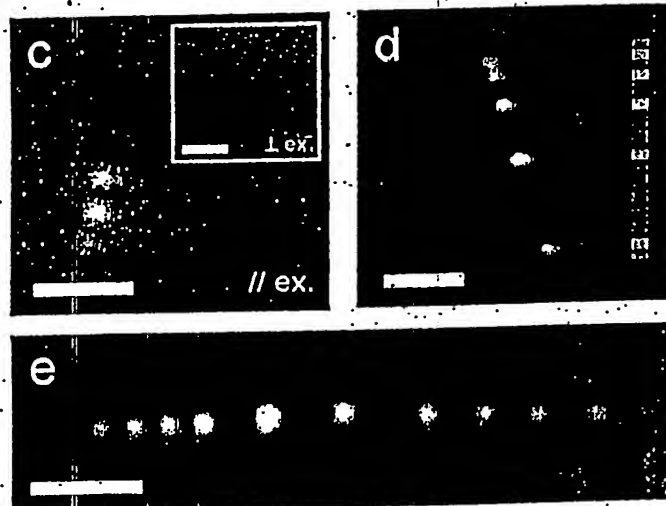


Fig. 69C

Fig. 69D

Fig. 69E

Fig. 70

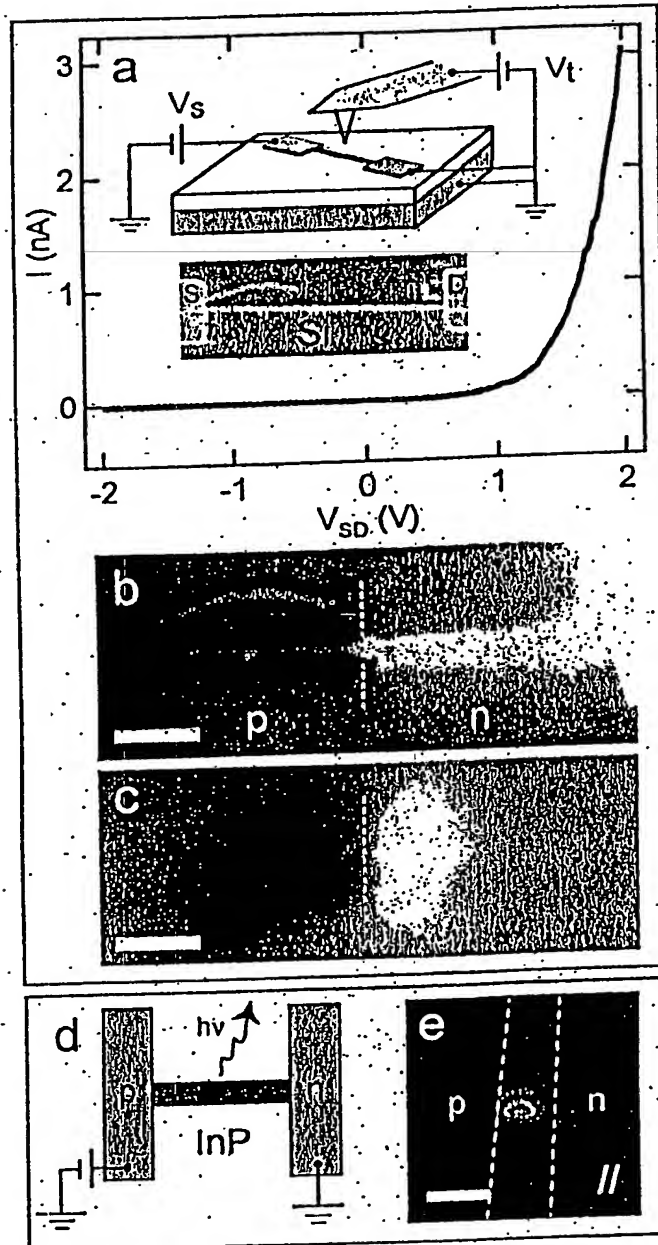


Fig. 70A

Fig. 70B

Fig. 70C

Fig. 70D

Fig. 70E

General fabrication approaches:

I. Direct growth

(a) Define nanocluster catalyst

(b) Initial LCG semiconductor growth



(c) Second LCG semiconductor growth



(d) Repeat (b) or (c) as desired

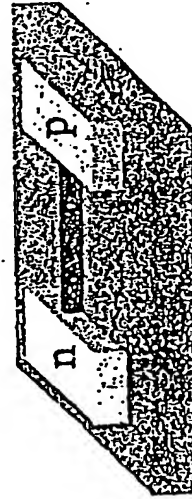


II. Post-synthesis functionalization

(a) Fabricate nanowire device



(b) Introduce dopants by annealing



Semiconductor heterojunctions can be synthesized within single wires by changing the semiconductor material during growth.

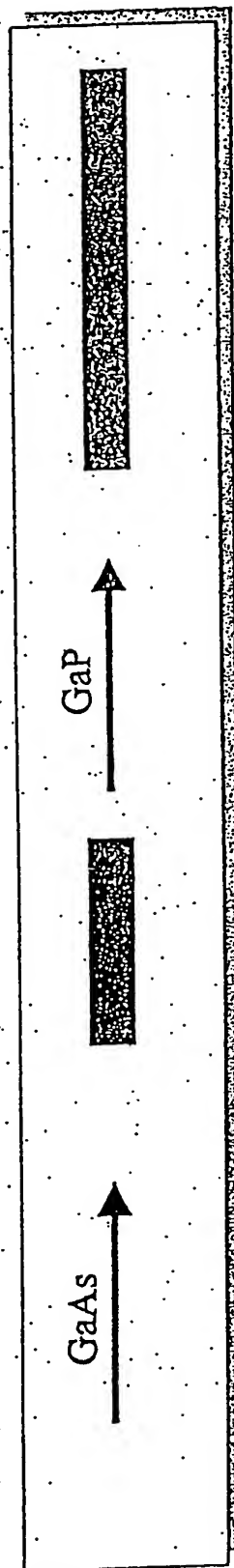
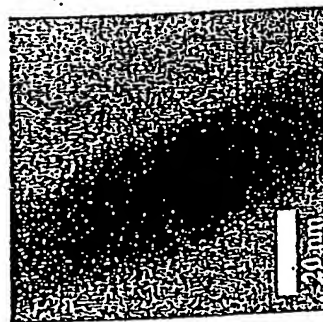
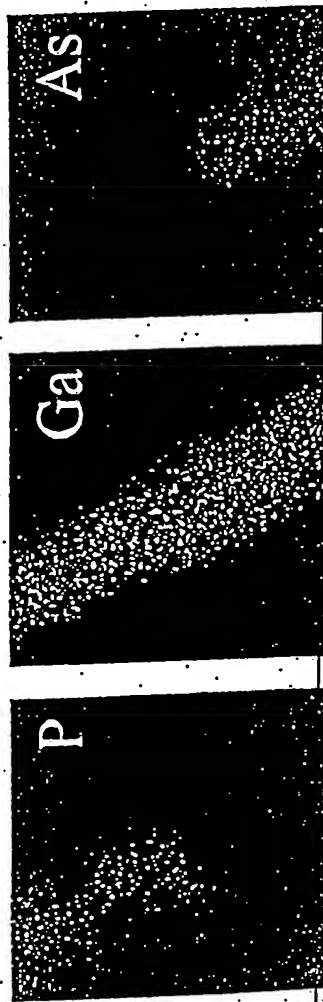


Fig. 72

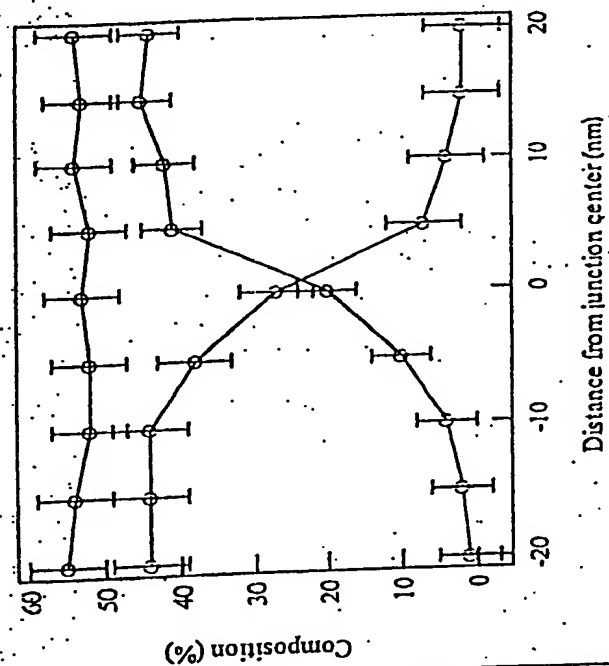
TEM Image



Elemental Mapping



Composition Profile



Single nanowire light emitting diode created by introduction of dopants from contacts

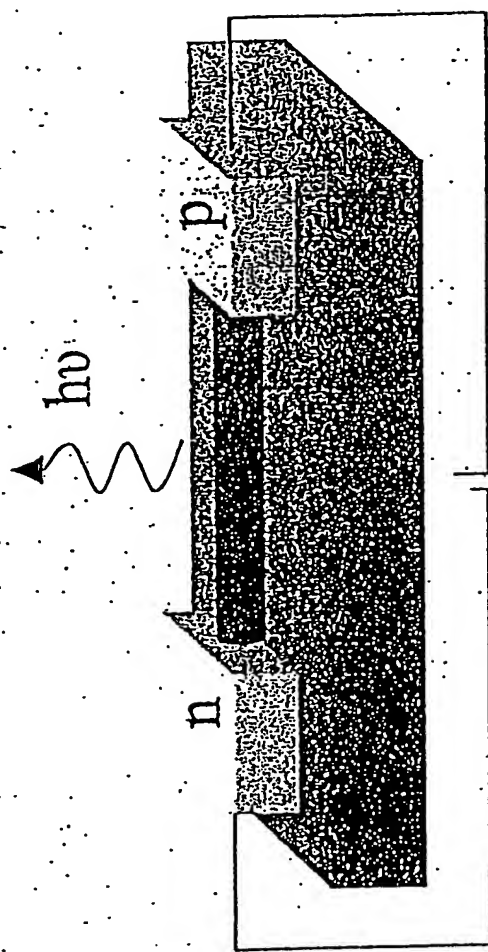
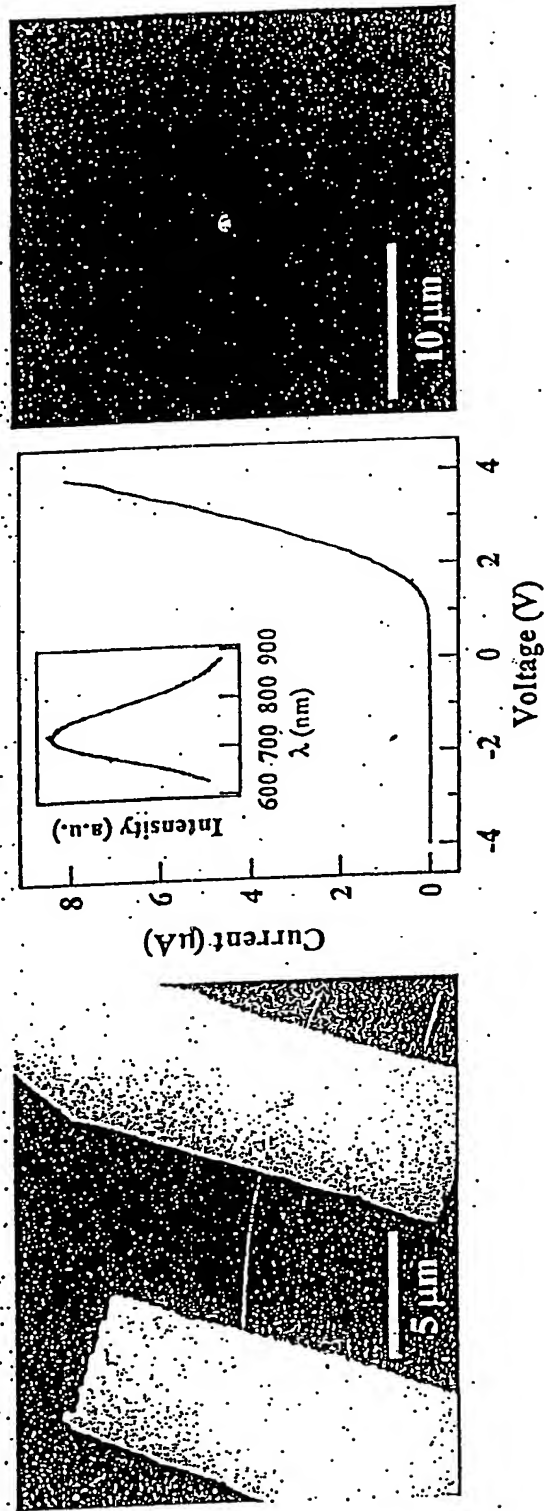


Fig. 73



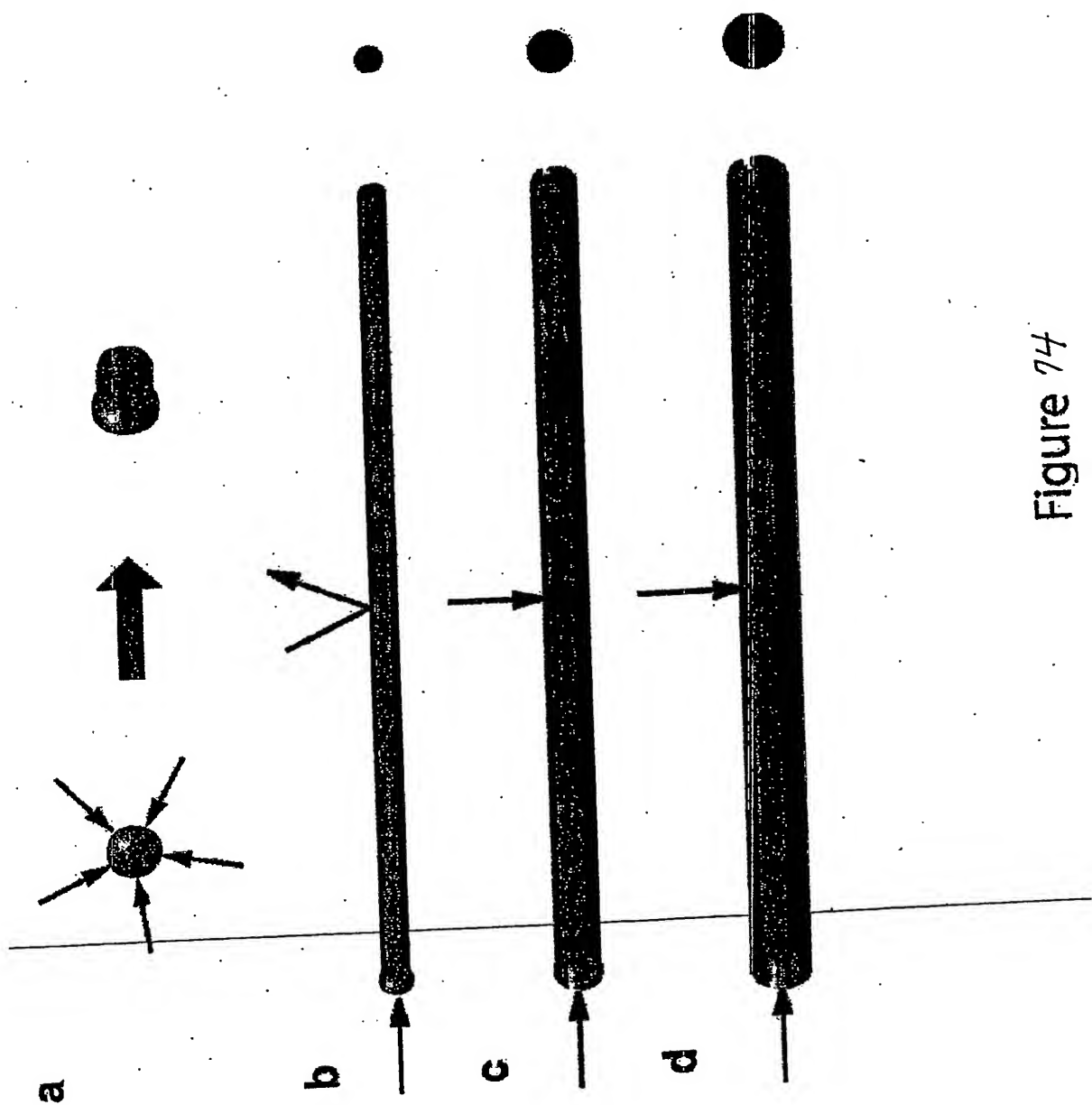
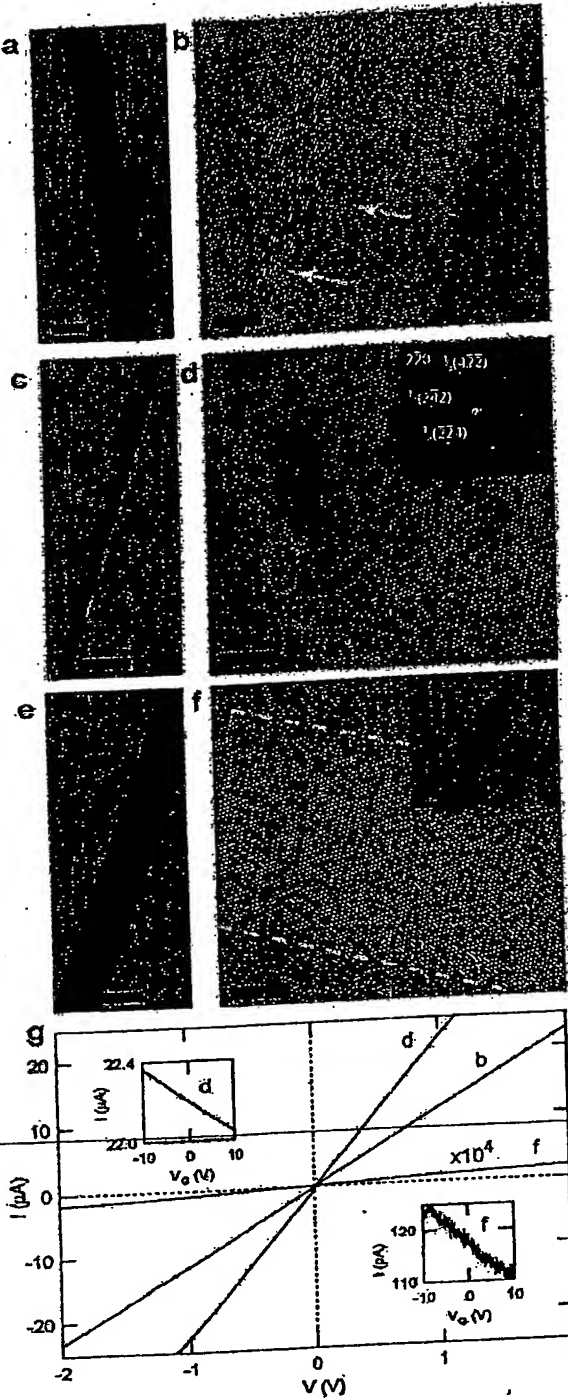


Figure 74

**Figure 75**

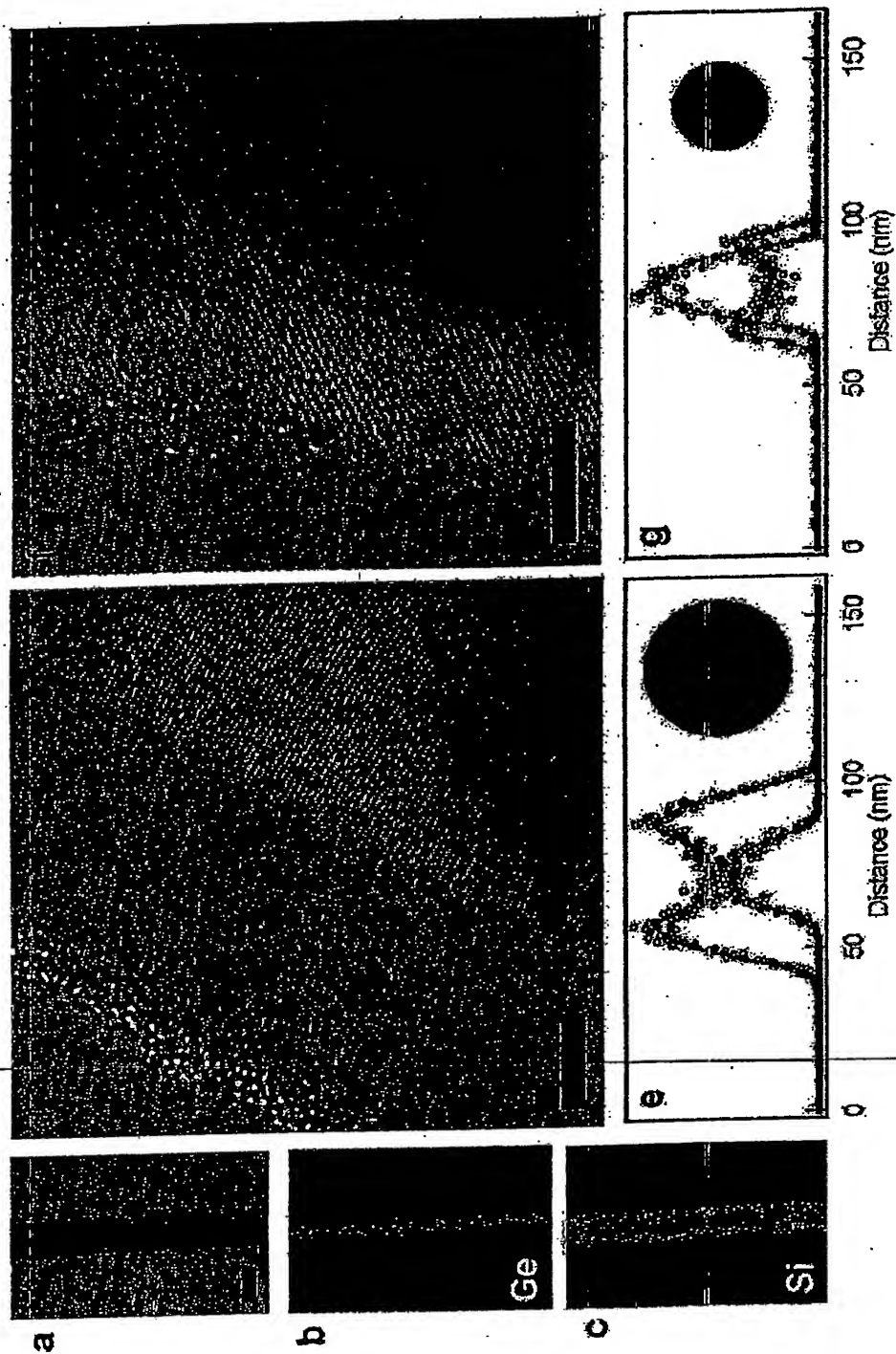


Figure 7c

H0498.70187US01

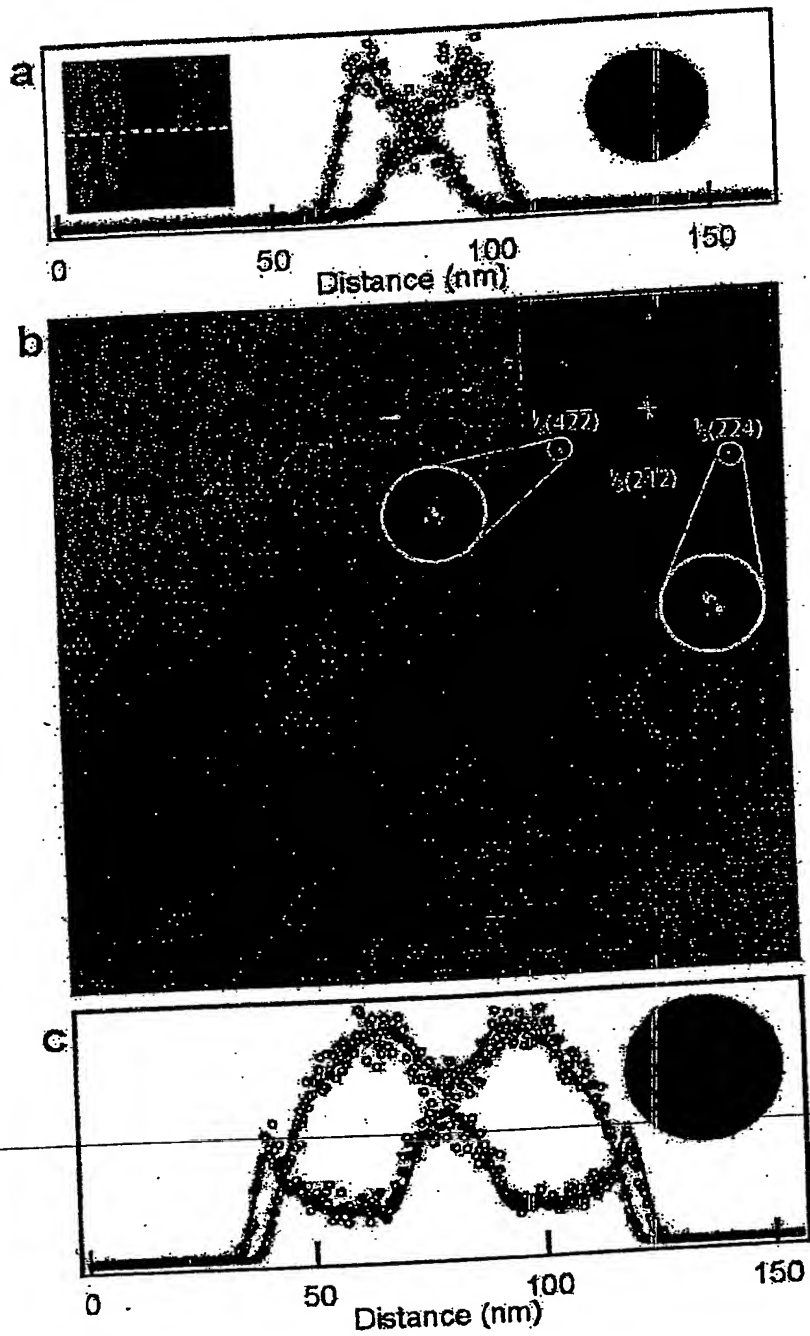


Figure 77

H0498.70187US01

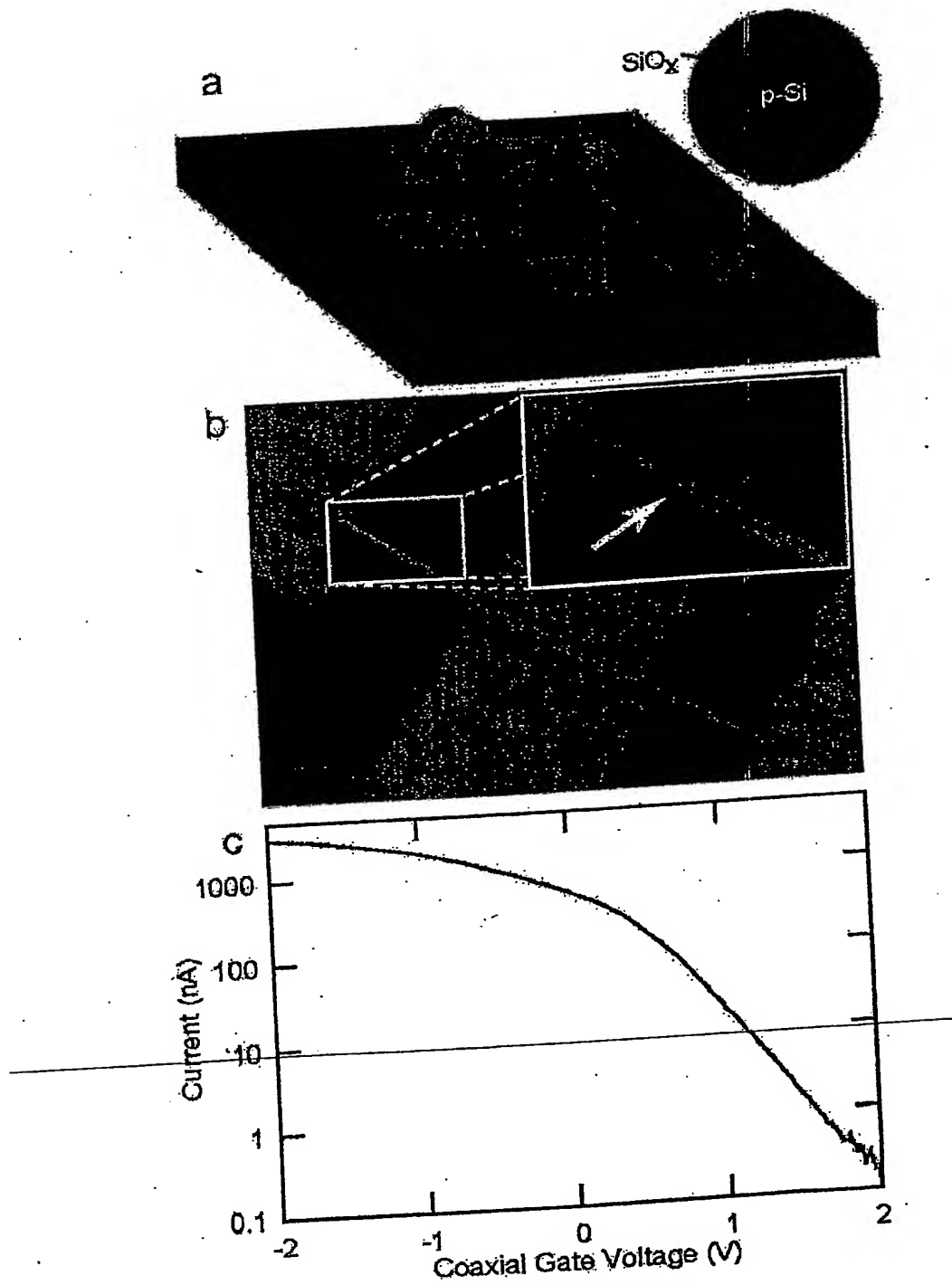


Figure 78